The Project Method of Teaching

SILK THROWING

PART 5

PREPARED UNDER THE SUPERVISION OF
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5002 E—FIRST EDITION

INSTRUCTION PAPER

With Examination Questions

PREPARED ESPECIALLY FOR
INTERNATIONAL CORRESPONDENCE SCHOOLS

Published by
INTERNATIONAL TEXTBOOK COMPANY
SCRANTON, PA.
1924

ADVICE TO THE STUDENT

You learn only by thinking. Therefore, read your lesson slowly enough to think about what you read and try not to think of anything else. You cannot learn about a subject while thinking about other things. Think of the meaning of every word and every group of words. Sometimes you may need to read the text slowly several times in order to understand it and to remember the thought in it. This is what is meant by study.

Begin with the first line on page 1 and study every part of the lesson in its regular order. Do not skip anything. If you come to a part that you cannot understand after careful study, mark it in some way and come back to it after you have studied parts beyond it. If it still seems puzzling, write to us about it on one of our Information Blanks and tell us just what you do not understand.

Pay attention to words or groups of words printed in **black-face type.** They are important. Be sure that you know what they mean and that you understand what is said about them well enough to explain them to others.

Rules are printed in *italics;* they, too, are important; you should learn to repeat them without looking at the book. With rules are usually given *Examples for Practice.* Work all of these examples according to the rules, but do not send us your work if you are able to get the right answers. If you cannot get the correct answer to an example, send us all of your work on it so that we can find your mistakes. Use one of our Information Blanks.

After you have finished studying part of a lesson, review that part; that is, study it again. Then go on with the next part. When you have finished studying an Instruction Paper, review all of it. Then answer the Examination Questions at the end of the Paper. It is not well to look at these questions until you have finished studying and reviewing the whole Paper.

Answer the Examination Questions in the same order as they are given and number your answers to agree with the question numbers. Do not write the questions. If you cannot answer a question, write us about it on an Information Blank before you send in any of your answers.

Remember that we are interested in your progress and that we will give you by correspondence all the special instruction on your Course that you may need to complete it. Remember, too, that you will get more good from your Course if you learn all that you can without asking for help.

 INTERNATIONAL CORRESPONDENCE SCHOOLS

SILK THROWING
(PART 5)

DOUBLING AND SPINNING

DOUBLERS

INTRODUCTION

1. For many purposes, threads are desired that have a greater strength and greater resistance to friction than are found in a raw-silk single. Since a raw-silk single consists of only one group of cocoon ends without any twist, it is likely to be broken if subjected to any process that frays its surface, or in which a strain is brought on the thread beyond the amount of strain that it is supposed to sustain. When, however, two or more single threads are placed together and twisted, or if the single threads are first spun or twisted in one direction, then wound on the bobbin, and twisted in a direction opposite to that in which they were first spun, threads of proportionately greater strength will be obtained. Silk yarns that are produced by merely twisting together several singles have a great tendency to fray when subjected to friction. In case the singles are first spun, then doubled. and twisted in a direction opposite to that in which they were first spun, the tendency to fray is largely reduced because each thread resists the tendency toward the separation of the filaments in the other thread or threads. Also, a ply thread composed of two or more single threads has considerably more strength than a single thread of the same weight as the ply thread; that is, by making a ply thread, a greater strength is obtained from the same weight of material.

2. The operation of combining and winding several threads on a bobbin prior to the twisting operation is known as *doubling,* while the machine on which the operation is performed is known as a *doubling frame,* or *doubler.* The object of doubling is to place on a suitable bobbin, without any twist, the desired number of threads that are to compose the ply thread. As the several ends of silk are wound on the bobbin, that is, doubled, the silk is not changed in any way but is merely transferred to another bobbin, preparatory to the next operation to which it is to be subjected.

3. Ply threads are used in weaving for both warp and filling, but the construction of the thread differs. The warp thread, that is, organzine, is composed of two or three singles that have been spun, doubled, and twisted in accordance with the usual methods. The filling, or tram, does not receive a first-time spinning, but is doubled and twisted with only a sufficient number of turns to hold the threads together, the slight twisting resulting in a loose fluffy thread with a good luster.

An illustration of the doubler, or as much as can be shown in any one view, is given in Fig. 1. As all the parts cannot be shown in one illustration, the details of the various parts are given in subsequent illustrations. As far as possible, corresponding parts in all illustrations have been given the same reference letters.

VERTICAL DOUBLER

4. Principal Parts.—An illustration of a standard type of vertical doubler, or jack-pin doubler, as it is also called, is shown in Fig. 1. After a careful study and comparison with the winder, it will be seen that many parts employed are common to both machines. The doubler, like the winder, is constructed with many parts on one side duplicated on the other; hence, the operation of doubling may be accomplished on both sides of the machine. The doubling frame, however, is nar-

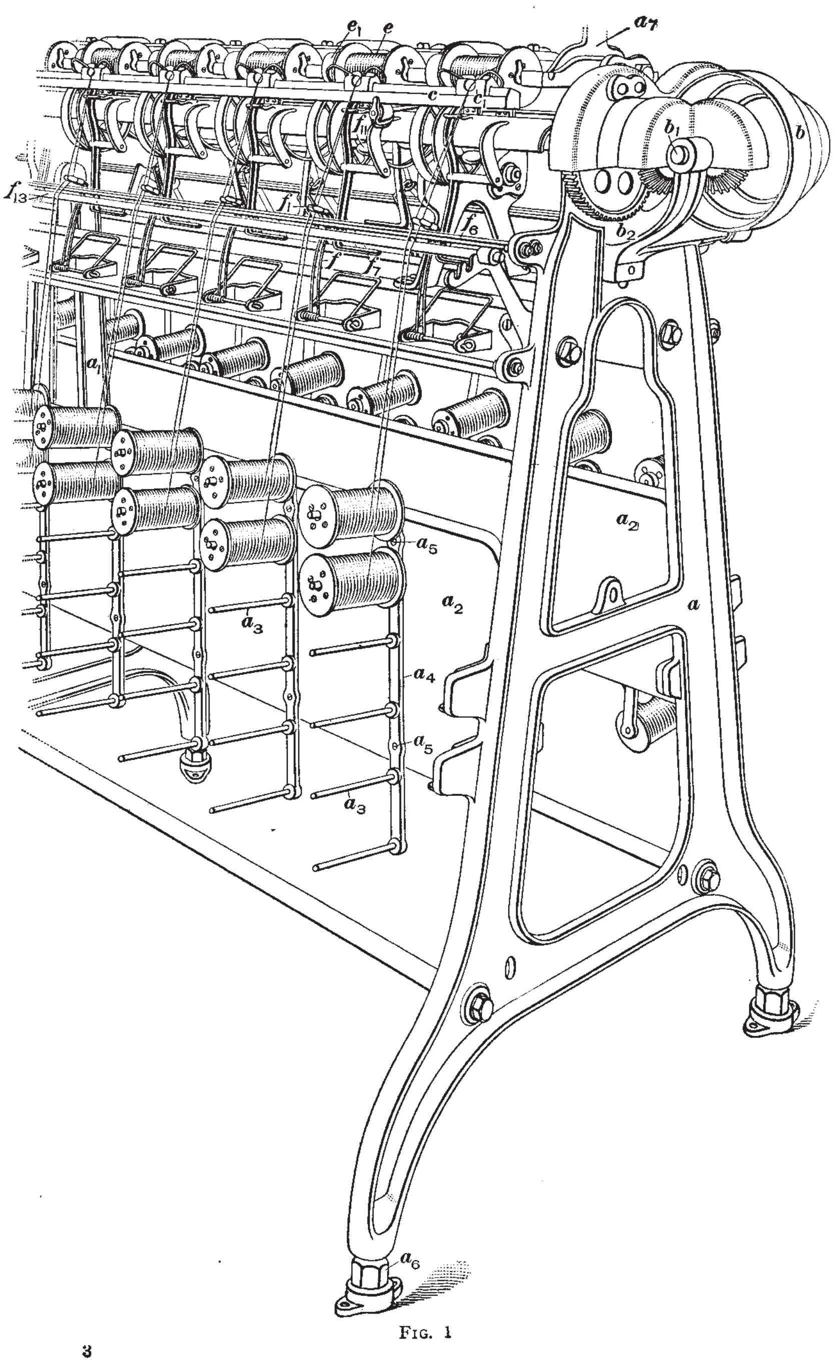


FIG. 1

rower than the winding frame, which is to be expected; for, instead of unwinding the silk from a skein supported on a swift, the silk is unwound from the bobbins that were filled in the winding operation.

5. In the doubler, Fig. 1, there are two end stands, of which the head end stand *a* supports the driving pulley *b*, which is of the three-step cone type. This pulley receives motion from the line shaft by means of a belt. The pulley imparting the motion it receives through various gears and shafts to the opposite end of the machine, causes a back-and-forth movement to be given to the wooden bar *c*, commonly known as the traverse bar; the movement, or traverse motion, of the traverse bar is derived from a cam, not shown, located at the foot end of the machine. The object of the traverse motion is to guide on the take-up bobbin *e*, which also is driven by pulley *b*, the several threads that are to compose the ply thread. As the ends are drawn upwards from the supply bobbins on the jack-pins a_3 they pass through the porcelain hook-guides f_1 attached to the drop wires *f* which are an essential part of the stop-motion.

6. Passage of Thread.—The several bobbins, according to the required ply thread, are placed on the jack-pins a_3, Fig. 1, where they revolve when the threads are pulled upwards. From the hook-guides f_1 the threads are led upwards and pass over the traverse bar *c* supporting the porcelain thread guides c_1, which are held in the same relative position and are adjusted in the same way as the porcelain guides on winders. On leaving the porcelain guide, the several silk threads, now in one group, are wound on the take-up bobbin *e* with a traverse movement that has been mentioned.

7. General Features.—The principal parts of the doubler have been outlined, and the passage of the thread from the bobbins on the pins to the doubler bobbin has been indicated. The more essential parts will be given a fuller description. In regard to its simplicity of construction the doubler may be favorably compared with the winder. On the winder, when a thread breaks during the winding operation, the bobbin continues to revolve, while the swift gradually comes to a stop. On the doubler, however, two or more ends are wound on the same bobbin. Should one end break and the other thread or threads continue to be wound, a doubled thread of less than the required ply would be produced. In order to prevent this, a stop-motion is applied to the doubler to stop the bobbin immediately when an end breaks and thus prevent the formation of *singles*.

8. Frame of Doubler.—The frame of the doubler consists of the end stands a, Fig. 1, and the middle stands a_1, connected by pipe ties. The stands are made of cast iron and are designed so that the various parts may be easily bolted in place. Held by the end stands of the machine are the jack-boards a_2, which are supported in grooves cast in the frame. The jack-boards are made of wood and vary in size according to the capacity of the machine. They also support the jack-pins a_3 on which the winder bobbins are placed. As it is desirable to have the machine level at all times, a leveling nut a_6 is located under each leg of the stands. This provides a means by which the machine may be quickly leveled; for, by applying a wrench to the leveling nut and turning it in the proper direction, the leg that it supports may be raised or lowered as required.

Small supports a_7 are bolted to the upper part of the frame to retain a bobbin shelf in its proper position. This bobbin shelf is of wood and has a small wooden edging or molding attached to its sides, to prevent the bobbins from rolling and falling from the shelf and thus causing broken ends, as they might fall and come in contact with ends that are being wound on the take-up bobbin.

9. Drive of Doubler.—The doubler illustrated in Fig. 1 is a belt-driven machine. A three-step cone pulley b is attached to the crosshead shaft and the steps are 4, 5, and 6 inches in diameter respectively. The machine may be driven from an overhead line shaft, or an individual motor may be mounted on the frame directly below the cone pulley. In either case the speed can be readily changed to suit various conditions. Instead of driving the spindle take-up shafts by two sets of bevel gears, as on the winder, two large spur gears are employed. This is possible since the doubler is much narrower than the winder; hence, the take-up shafts are in closer proximity to each other, which allows the use of two spur gears.

10. The crosshead shaft b_1, Fig. 1, is held in place by a bracket b_2 bolted to the end stand a. In Fig. 2 (a) and (b),

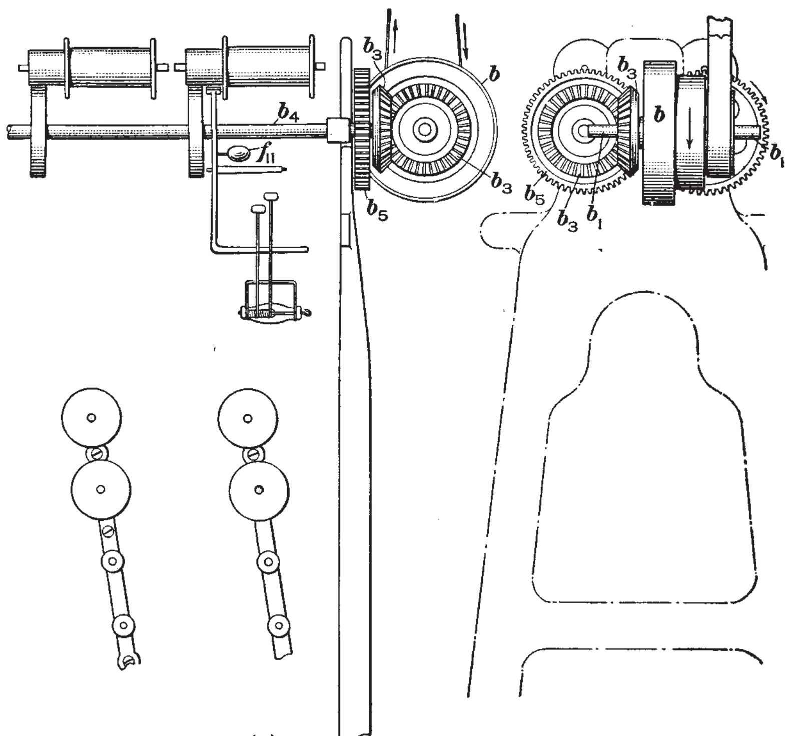


Fig. 2

which are detailed illustrations of the driving mechanism, it will be seen that two 36-tooth bevel gears b_3 transmit motion from the crosshead shaft to the take-up shaft b_4. Adjacent to the bevel gear b_3 on the take-up shaft b_4 is a large spur gear b_5 that has 63 teeth and that meshes with another gear of the same size attached to the opposite take-up shaft. Therefore, when the machine is in motion, both take-up shafts are driven at the same speed, since the gears that mesh have the same number of teeth.

11. Jack-Pins.—As already mentioned, the silk is unwound from the winder bobbins on to the take-up bobbins of the doubler, which are also known as spinner, or twister, bobbins. The winder bobbins are placed on jack-pins a_3, Fig. 1, attached to iron bars a_4 known as pin-rails, which are in turn attached at a_5 to the jack-boards a_2 that run the entire length of the machine, and are held in grooves cast in the end stands. The number of jack-pins in one row, that is, attached to one pin-rail, designates the size of the frame when referring to the number of ends that may be doubled. Thus, if ten pins are in a row, there will be ten bobbins in a row; and since the threads from all are wound on one take-up bobbin, the frame is known as a 10-end doubler. The jack-boards of the 8-end and 10-end frames are fixed, while the jack-board of the 6-end frame is reversible; that is, it may be moved from its almost vertical position and placed horizontally, the thread being pulled over the head of the bobbin, which remains stationary on the pin and does not revolve.

12. Doubling over the head of the bobbin is sometimes resorted to when the silk is poor and not of sufficient strength to withstand the tension on it when unwinding from the side. When doubling over the head, a circular iron weight or cap is placed on the bobbin so that it will be held in place and will not be pulled upwards with the thread as it unwinds. The cap also prevents the silk from coming in contact with the bobbin head. This latter precaution is necessary, as bobbin heads often become damaged while being handled in the mill. Such small rough places and scratches would catch the thread and cause it to break, if the iron cap were not employed.

In passing to the take-up bobbin, the silk is guided over a board, or girth, covered with plush, and often referred to as a plush-board, from which the term *plush doubling* originated. The plush is employed to give the desired tension to the thread as it is wound on the take-up bobbin in the same manner as on vertical doublers. Sometimes a figure 8 flyer, similar to the flyer employed in twisting ply yarns, is used in conjunction with this type of doubling. The use of a flyer, however, is gradually decreasing because of the difficulties encountered which materially reduce the production of the frame.

13. The jack-board is inclined so that the top is slightly closer to the center of the machine than the bottom, as may be seen in Fig. 1. This causes the pins a_3 to point upwards slightly. If they were horizontal, the bobbins in revolving would have a tendency to move outwards and fall from the pins. With the jack-board inclined, the bobbins have a tendency to slide toward the pin-rail. The pin-rails a_4 that hold the pins a_3 are also attached to the jack-board at a slight angle; that is, the top pin is slightly to the left of a vertical line drawn through the bottom pin on the pin-rail. The object of this arrangement is to prevent the silk that is unwinding from the bottom bobbins from coming in contact and tangling with the silk unwinding from the bobbins higher on the pin-rail.

14. Stop-Motion.—The principal object of a doubler is to wind on a take-up bobbin a certain number of ends, and it is of the utmost importance that the required number of ends be wound on the take-up bobbin at all times. To aid in accomplishing this, all doublers are equipped with stop-motions to stop the take-up bobbin if a single end breaks while passing from the winder bobbin on the jack-pin to the take-up bobbin. The stop-motion is located at a point between the supply bobbins and the take-up bobbin. Each end that passes from a winder bobbin to the take-up bobbin is threaded through a drop wire, which is held upright by the tension of the thread. In case an end breaks, the drop wire that it supports will fall, and by a suitable mechanism lift the spindle head from the spindle-driving pulley or friction wheel and stop the take-up bobbin. The relative positions that the drop wires occupy on the doubler is shown at *f*, Fig. 1, while the mechanism of the stop-motion itself is shown in Fig. 3 (*a*) and (*b*).

15. The drop wires, one for each thread to be wound on the take-up bobbin, are shown at f, Fig. 3 (a) and (b). They are constructed of heavy wire and are bent to the shape shown.

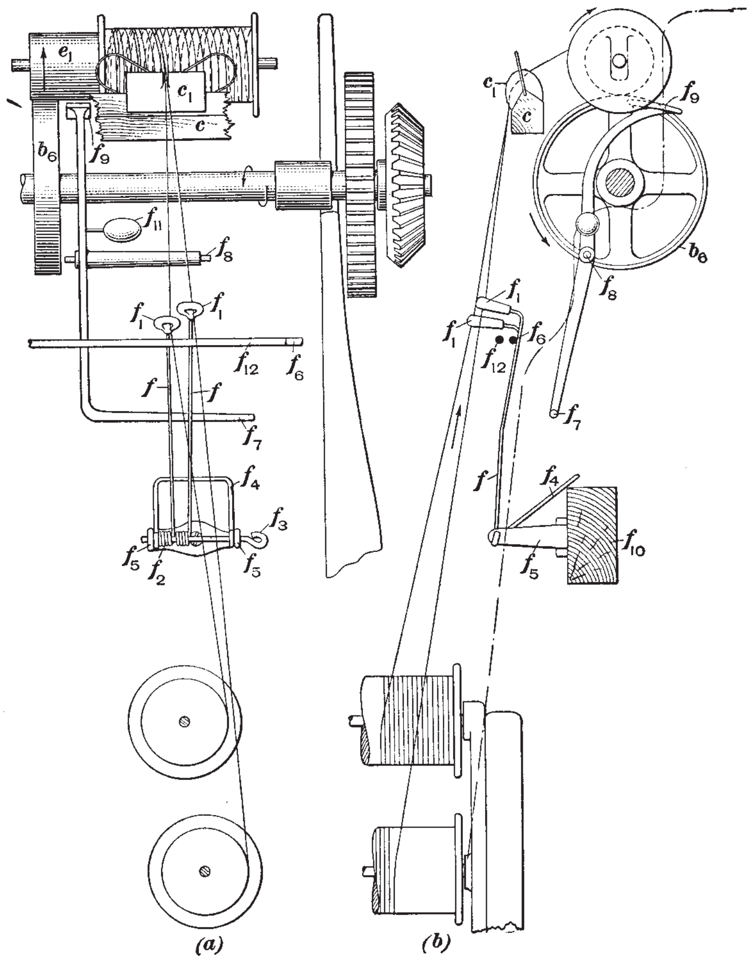


Fig. 3

The upper end supports the porcelain hook-guide f_1, while the opposite end is coiled into a bearing f_2 through which passes the pin f_3 that supports the drop wires. Also supported on the pin f_3 is a wire f_4, bent in the shape of an inverted **U**, and shown resting against the wooden rail f_{10}, which is its normal position. The purpose of this wire is to assist the operative in bringing the drop wires in an upright position, which is usually done when tying an end. By grasping the wire f_4 and swinging it forwards, all the drop wires will naturally be brought with it. This wire is especially useful where six or more ends are doubled, for it is sometimes difficult to place a finger behind all the drop wires and draw them forwards. The pin f_3 supporting the drop wires and the wire f_4 is held by a hanger f_5 screwed to the wooden rail f_{10}.

16. To prevent the drop wires from moving too far forwards, and also to keep them in line, a rod or front rest f_6, Fig. 3, is provided. This rod extends the entire length of the machine and is attached to an extension of the end stand by nuts on the threaded ends of the rods. This method of attachment provides a means for keeping the rod tight and preventing vibration. It will be noted that the rod f_6 is not directly above the pin f_3, but is slightly toward the center of the machine. The reason for this construction may be explained as follows: While the threads are intact and running, the drop wires will be held against the front rest. Should an end break, the tension will be released immediately, and the drop wire will be free to fall backwards. This tendency, naturally, is increased by locating the rod f_6 slightly to the rear of a vertical line through f_3, giving the drop wire a more rapid action and increasing its sensitiveness.

17. When an end breaks, the drop wire falls backwards and comes in contact with the faller, or spindle brake. The faller is an iron casting having an arm or projection f_7, Fig. 3, that intercepts the released drop wire. The faller is delicately balanced on a pin f_8 attached to the machine. It should occupy the position shown in the illustration when all the ends are intact and passing through their respective drop wires. When in this position, the brake shoe f_9 should be almost directly under the spindle head e_1 and slightly toward the center of the frame.

In operation, the weight of a single drop wire resting against the arm f_7 will cause the faller to swing on the pin f_8. As the lower part of the faller is moved toward the center of the frame, the shoe f_9 will move toward the spindle head. Moreover, as the edge of the shoe strikes the revolving spindle head, the motion of the latter will cause the shoe to move forwards. Also, due to the design of the shoe, it will be drawn under the spindle head, and because of the angle of its surface in relation to the faller, it will cause the spindle head to be lifted. This action causes the spindle head to lose contact with the rotating friction wheel b_6, with the result that the spindle and bobbin cease revolving.

18. Sometimes the faller is found to be incorrectly adjusted, so that the shoe f_9, Fig. 3, comes in contact with the spindle head even though all the threads are intact; again, at times the faller may not operate even though a drop wire rests against the arm f_7. When either of these conditions is found, or should it merely be desired to give the faller a more delicate adjustment, the lead balance weight f_{11} is provided to complete the adjustment. The balance weight is supported on a wire attached to the faller so that its position may be easily changed by bending the wire. Because of its position, a slight alteration in the position of the weight is sufficient to change the balance of the faller.

19. Reference has been made to the front rest f_6, Fig. 3. It will be noted that at the same height and only a slight distance away from the front rest is a rod f_{12} of the same size. This rod is sometimes employed to support sliding wire hooks for holding any drop wires that may not be in use. It frequently happens that frames equipped for 6-end doubling are doubling only two threads; in this case the four unused drop wires must be supported in an upright position, or the empty drop wires would fall backwards and cause the faller to stop the operation of the spindle.

A third rod f_{13}, Fig. 1, is located on the machine. It is held in a notched support attached to the end stand, so as to allow for adjustment of the thread tension. The thread as it is guided upwards passes over the rod f_{13}. Should the rod be shifted to the second or third notch, that is, away from the machine, the tension on the thread would be increased; for, the thread would be pulled over the rod at an angle instead of passing directly upwards in the line of least resistance to the take-up bobbin.

20. Bobbins.—The bobbins placed on the jack-pins of the doubler and considered the supply bobbins, are received either from the winder or from the first-time spinner. Should the silk be received from the winder, it may be delivered on ordinary all-wood bobbins or on suitable fiber-head bobbins, both of the straight-hole type. This, of course, is the proper sequence of operations in the manufacture of tram, crêpe, and other yarns that require the doubling of untwisted ends prior to twisting into a ply yarn. If the silk is received from the spinner, which occurs in organzine throwing in which the spun threads are doubled prior to twisting, the silk is usually delivered on fiber-head bobbins, also of the straight-hole type.

21. In Fig. 4 is shown a cross-section of a typical take-up bobbin employed as a supply bobbin on the doubler. It is similar in construction and size to the organzine bobbin described in connection with winding operations. However, when considering the take-up bobbin on the doubler, in comparison with winder bobbins, it should be noted that a single type of take-up bobbin is employed when throwing tram, organzine, crêpe, or other yarns where it is necessary to place two or more threads on a bobbin, preparatory to twisting to form a ply yarn. For this reason, the take-up bobbin is invariably equipped with a tapered hole, in order that it may be placed on the tapered spindle of the twister.

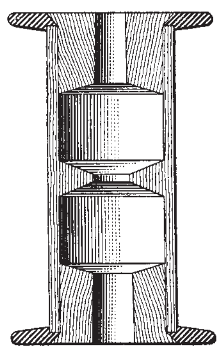


Fig. 4

22. Spindles.—The spindles that support the take-up bobbins are constructed with either wooden or iron heads.

Wooden-headed spindles are sometimes used where only a few threads are doubled; iron-headed spindles are, however, almost always used, because the spindle head must bear with greater pressure on the friction wheel in the doubling operation than in the winding, since at times up to ten ends must be wound on the take-up bobbin and ten bobbins turned. The spindles are similar to the winder spindles in size, and consist, as shown in Fig. 5 (*a*), of a cast-iron head e_1 and a steel gudgeon e_2 securely fastened together. The spindle holds the bobbin firmly by means of a thumbnut, or screw-button fastener e_3, which is screwed against the bobbin when in place. A left-hand thread is usually used on the gudgeon and thumbnut, which causes the thumbnut to become tighter when there is any slippage of the bobbin on the spindle, and thus holds the bobbin more firmly, since the thumbnut turns in the direction necessary to tighten it.

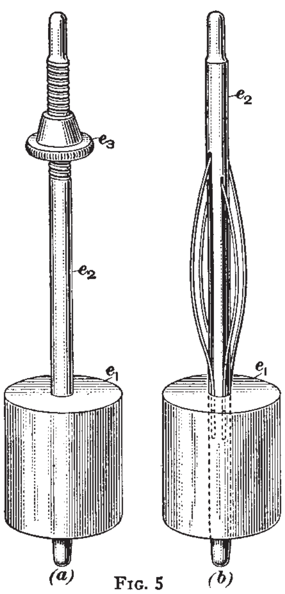


FIG. 5

23. The thumbnut e_3, Fig. 5 (*a*), is made of brass or steel and has a shoulder on the outside, while the other side is flat. The reason for this construction is that the bobbin may be placed on the spindle with either the small or the large hole of the taper first. If the small hole is placed on the spindle first, the thumbnut is screwed on the spindle with the shoulder first or toward the bobbin. The shoulder, fitting into the large hole, acts as a support, holding the bobbin firmly and preventing it from wobbling. However, when the bobbin is placed on the spindle with the large hole first, the thumbnut is reversed, and the flat side is placed against the bobbin and firmly screwed into position.

24. Use is also made of the doubler spindle equipped with four piano-wire springs, as illustrated in Fig. 5 (*b*).

This spindle closely resembles one style of spindle commonly found on winders, with the exception that an iron head e_1 is used instead of one made of wood. The gudgeon e_2 is designed to hold four springs; that number of springs is always employed in a spring spindle that is used on a doubler since it must hold a taper-hole bobbin. While this spindle is more advantageous in the quick removal and replacement of bobbins over the screw-button type, it is not employed to a great extent, as the springs become weak and allow the bobbin to slip and move away from the spindle head, resulting in a badly traversed bobbin.

25. Traverse Motion and Cam.—The traverse motion and cam of the doubler are of practically the same construction as on the winder, and operate in a similar manner. An illustration of the traverse bar, guides, and cam drive is given in Fig. 6. The wooden traverse rail *c* carries porcelain thread guides c_1 held by spring wire bows. The traverse bar is supported on the traverse fingers c_2 that have small wooden rollers held on pins; the rollers revolve as the bar moves back and forth and thus reduces the friction. The traverse motion imparted to the traverse bar, is produced by a cam *d* driven through gearing from one of the take-up shafts b_4. The cam is constructed like the winder cam and is designed so that the throw may be easily adjusted by altering the positions of the setscrews in the cam hub. The variable thrust motion is also given to the cam, produced by the revolution of the gears d_1 and d_2. These gears are equipped with different numbers of teeth, so that the cam follower cast on the inner side of the gear d_1 will gradually move around the cam on the gear d_2, producing the thrust motion.

26. Since the doubler is a narrow machine, only one cam is employed to operate both traverse bars. The cam roller d_3, Fig. 6, which may rotate on the pin d_4, is held in constant contact with the cam. The pin d_4 is attached to the traverse lever d_5, which carries a cross-bar d_6. The cross-bar is located between the two traverse levers and the extension spring d_7 is attached to the bar and the end stand. The spring retains the cam rollers of both traverse levers in constant contact with the face of the cam. At the upper end of the traverse lever is a spring stud d_8 that engages with the traverse-bar connection d_9, which, in turn, is fastened to the traverse-bar iron d_{10}, the latter being firmly attached to the traverse bar *c*.

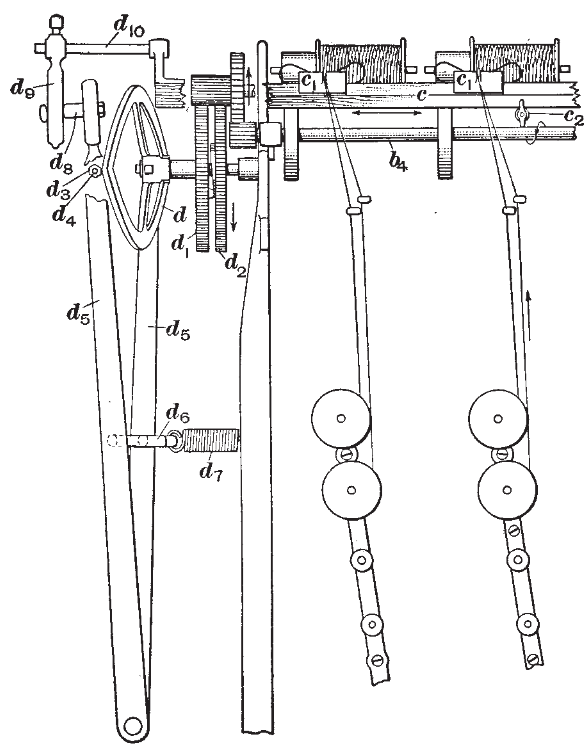


Fig. 6

Should the thread be improperly guided on the bobbin while the machine is in motion, adjustments of the traverse motion should be made accordingly. If the length of traverse is correct, but the thread is guided high on one side and low on the other side of only one bobbin, the porcelain thread guide should be adjusted until the thread is guided properly. Sometimes the traverse bar catches and is moved slightly, causing the preceding fault to happen to all bobbins. When this occurs, the setscrew on the traverse-bar connection should be loosened and the bar moved in the proper direction until the thread is guided properly. The setscrew should then be firmly tightened.

27. It is considered better practice to wind the thread on the take-up bobbin of the doubler with a quicker or more rapid traverse than is usually employed when winding the thread on a winder bobbin. This is especially true if certain difficulties, as continued breakage of the thread near the bobbin heads, results in the twisting operation. The object of this winding procedure is to cause a quick return of the traverse bar after it reaches the limit of its throw in order that the silk will not be wound so as to produce a bobbin with the silk wound loosely adjoining the heads. This defect is commonly referred to as *soft ends*. Bobbins that have soft ends usually run poorly when twisting, since the thread pulls and catches in the loose silk, causing unnecessary breakage, and consequently increasing the amount of waste.

OPERATION OF DOUBLER

28. Preliminary Operation.—A taper-hole take-up bobbin is first placed on the doubler spindle and the brass thumbnut is tightly screwed against the bobbin head to prevent the bobbin from turning when it is brought into motion. Next, the winder bobbins on which the raw silk has been wound are placed on the jack-pins of the doubler. While performing this, care should be taken to see that all the bobbins are placed on the jack-pins so that they will revolve in the proper direction; that is, the bobbins should turn in a counter-clockwise direction when the operative faces the frame.

It is also well to note the condition of the bobbin heads. Sometimes, due to dampness and other causes, the heads become warped. A bobbin with a warped head should not be placed so that the warped head adjoins the pin-rail, for these parts are likely to rub, causing an increased amount of tension, with possibilities of uneven doubling.

29. The ends from all the bobbins are grouped together and should be held in the left hand, which should be raised until a sufficient quantity of silk is pulled from the bobbins to enable the threads to pass the drop wires. All the drop wires should next be moved forwards with the right hand and the proper ends of silk arranged in their respective drop-wire eyes; that is, the end from the top bobbin on the jack-pins should be placed in the drop-wire guide adjoining the left side of the bracket f_5, Fig. 3 (a). Likewise, the end from the second bobbin should be threaded through the second drop-wire eye, and so on until all the ends are in their respective guides.

30. The group of threads, after being put through the drop-wire eyes, should be wrapped around the barrel of the take-up bobbin, which is held in the right hand. The threads should be wrapped around the barrel and not tied, as this is unnecessary and would cause the thread to break in the succeeding operation and probably result in the breakage of other threads. A finger of the left hand should be placed behind the group of threads at a point between the drop-wire eyes and the porcelain thread guide on the traverse bar and the threads should then be gently drawn toward the operative. The bobbin, still held with the right hand to prevent it from turning while removing the slack, is deposited, together with the spindle, in the slot in the fingers, and the spindle head is allowed to come in contact with the revolving friction pulley. The threads will commence to wind on the bobbin and naturally slip through the attendant's fingers. As this occurs, the left hand should be gradually shifted toward the frame and the group of threads deposited in the traverse guide. The object of holding the threads in this manner and then gradually allowing them to assume a normal position in the guides is to start all bobbins on the jack-pins very gradually and thus prevent excessive breakage of the threads in this operation.

After the take-up bobbin has started winding the thread, the porcelain thread guide should be adjusted so that the thread will be evenly distributed between the heads of the bobbin, and not wound high on one side and low on the other. Uneven winding produces a badly shaped bobbin that runs poorly and is the cause of considerable trouble and waste in the next operation to which the silk is subjected. Defective traversing and winding on the take-up bobbin may be remedied as described in a previous Section.

31. Tying Ends.—Since the stop-motion is very sensitive, the spindle is lifted almost immediately from the spindle friction pulley when a thread ceases to pass through a drop-wire eye; or if the tension of the thread is relieved, the stop-motion will act in the same manner, provided, of course, that all parts of the stop-motion are in proper working order. If the thread has broken or run out from one of the bobbins on the jack-pins, the end from the take-up bobbin is still in the drop-wire eye, or hanging from the bobbin. The end from the take-up bobbin should be tied to the proper end from the bobbin on the jack-pin, placed in its drop-wire eye, and the take-up bobbin should again be started.

Sometimes, after a thread has broken, the bobbin makes several revolutions before the stop-motion acts. When this occurs, all the ends that have been wound on the take-up bobbin must be pulled back and removed, until the broken end is found. When threads are being pulled back, the silk is usually wrapped around the operative's fingers, from which it may be easily removed and deposited in a waste bag. A sufficient amount of thread should be removed to insure that the broken end is contained in the group, and not lapped under ends that have been wound on the bobbin after the breakage of the thread. When it is sure that the group of threads have been found as they were previously wound on the bobbin, they should be tied to the group of ends from the bobbins on the jack-pins, using a small knot and cutting the tails from it with a scissors. The take-up bobbin may then be started, as previously described.

32. From the preceding paragraphs it may be seen that it is very important that the stop-motion should be in good working order at all times. This will eliminate pulling back threads and thus reduce the percentage of waste that is made. It is evident, when doubling for, say, ten-thread tram, the waste will be increased ten-fold over winder's waste. Also, the tying of large groups of threads results in large knots, which are very objectionable, as they are likely to show as imperfections in the finished fabric, by causing other threads to catch on them, or cause tight marks as they pass through the machine. When an end from a winder bobbin on the jack-pins breaks, the cause should be determined, if possible, and traced to the operative responsible for it. Thus, the efficiency of the attendants may be increased, the production of the machines will be greater, and the quality of the product will be higher. Finally, when the take-up bobbins become filled with silk, they should be doffed, and the bobbins should be placed on bobbin boards, or in suitable receptacles for holding them until needed.

33. General Care.—It is very important, in the production of good work from the doubler, that all parts which come in contact with the thread and with the bobbin be in the proper condition. For instance, the thread guides should be smooth and not cut or grooved, so that the silk will not be scratched. The jack-pins should be kept clean and bright; rust spots should be removed by a light application of emery cloth; and gummy substances and waste should also be carefully removed. Waste that is wound around the jack-pins is usually removed with the aid of a knife, and it is important when performing this task that the blade be held at an angle that will not allow it to scratch the pin. Since the bobbins must turn freely, porcelain washers are often placed on the jack-pins between the bobbins and the pin-rail, thus removing a considerable amount of friction. Also, the pins are often oiled, a few drops being applied to each pin about twice each week, which greatly facilitates the revolving of the bobbin.

34. Winding for Right or Left Twist.—The direction of twist, of course, depends on the decision of the customer; but when no stipulation is made as to whether it should be right or left twist, the class of yarns to which it belongs will determine its direction. Thus, in two-thread organzine, the single thread is spun 16 turns of twist to the left and two single threads are doubled; then, the doubled thread is twisted in an opposite direction, with about 14 turns of twist to the right. Tram, on the other hand, is given about 3 or 3½ turns of twist to the right.

In the preparation of the silk thread for the spinning or twisting operations, one important condition must be fulfilled before the twist may be inserted. The thread must be wound on a bobbin in the proper direction, which is determined by the

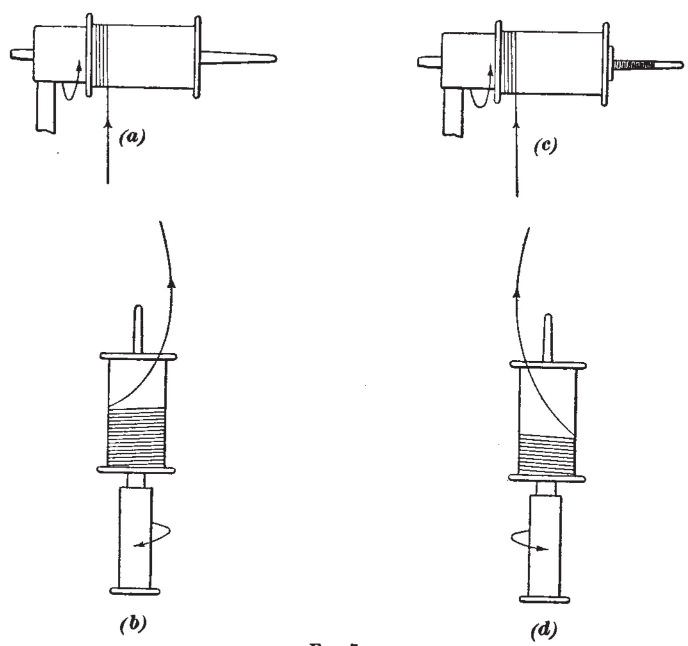


Fig. 7

twist that is to be inserted in the twisting operation; that is, should the silk be wound on a bobbin for right twist, only right twist may be inserted, and similarly for left twist.

35. In throwing organzine, which is twisted in the single, prior to doubling, a taper-hole bobbin that is to be used for the first spinning must be placed on the winder spindle so that it will take up the thread to allow a left twist to be inserted in the thread while the bobbin containing it is on the spinner. Fig. 7 (*a*) is an illustration of a taper-hole bobbin placed on a winder spindle in the proper manner to take up the thread so that a left twist may be inserted in the thread on the spinner. The large hole of the bobbin is first placed on the winder spindle and the bobbin is firmly pressed against the spindle head, where it is securely held by the action of the piano-wire springs. The spindle has a tapered gudgeon that is commonly employed on winding frames when the major portion of the production of the throwing mill is organzine. However, straight-gudgeon threaded spindles with screw-button fasteners may be employed, if desired, while straight-gudgeon spring spindles may also be used; but the latter allow the bobbins to wobble, which is undesirable.

36. After the bobbin is filled with silk it should be removed from the winder spindle and placed on the tapered spindle blade of the first-time spinner, which will hold the bobbin in only one manner. That is, the large hole of the bobbin is placed on the spindle first and the bobbin is pressed downwards until it is firmly held in place. When the thread is pulled from the bobbin in the horizontal direction, it will be drawn from the left side as illustrated in Fig. 7 (*b*), which is correct for left twist. The direction of rotation of the spindle is shown by the arrow. As shown, the spindle is rotating in the correct direction to produce a left twist in the thread. The direction of rotation of the spindle may be easily determined when the frame is in motion by grasping the blade between the fingers. Should it be found to revolve in a clockwise direction, it will be known immediately that a left twist will be inserted in the thread when a bobbin wound in the correct manner is placed on the spindle. It may be explained here, that the term clockwise refers to the rotation of the spindle in relation to the hands of a clock. Thus, when it is said that a spindle is turning clockwise it is meant that when looking down on it, the direction of rotation will be the same as the movement of the hands of a clock. In like manner, the term counter-clockwise indicates that the spindle revolves in a direction opposite to the movement of the hands of a clock

37. After the first twist is inserted in the single end, the take-up bobbins are removed from the first-time spinner and placed on the jack-pins of the doubler. Here two spun threads are doubled, being wound on a suitable taper-hole take-up bobbin, which is placed on the spindle of the twister when filled. The two threads, now grouped as one, are to be twisted in an opposite direction to that in which they were first spun; hence, it is necessary to wind the thread on the take-up bobbin of the doubler in a different manner and also turn the spindles of the twister in an opposite direction. In order to accomplish this on the doubler, it is necessary to place the bobbin on the spindle just opposite to the method employed for the first-time spinning; that is, the end of the bobbin that has the smaller hole is placed on the spindle first, as illustrated in Fig 7 (*c*). Then the brass screw button is put in place with the shoulder toward the head of the bobbin, so that it will be accommodated by the large hole of the bobbin. When the screw button is firmly drawn into place, it will keep the bobbin from wobbling.

The take-up bobbin filled with the doubled thread should be removed from the doubler and placed on the spindle of the second-time spinner in order to insert the right twist into the doubled thread. The thread when pulled from the bobbin in a horizontal line should be drawn from the right side of the bobbin, as illustrated in Fig. 7 (*d*), while the spindle should revolve in a counter-clockwise direction, as indicated by the arrow, in order to insert a right twist in the thread.

38. The nature of the thread, which is governed largely by the number of plies, the twist, and in some cases by the special instructions given to the throwster by the customer, determines the direction in which it should be wound on the taper-hole bobbin in winding or doubling. Thus, if the throwster is ordered to impart a right twist to a single end, it is necessary to place the bobbin on the winder spindle so that the thread will be wound on the bobbin in the correct direction that a right twist may be inserted. This will require the bobbin to be placed on the spindle so that the head containing the small hole will adjoin the spindle head. This cannot be accomplished, however, with the tapered spindle illustrated in Fig. 7 (*a*), for it would be impossible to place the small hole of the bobbin on the gudgeon and press it into place. For this reason, it is necessary to provide straight-gudgeon spindles for this type of work. They may be equipped with screw-button fasteners similar to the one supplied on the spindle illustrated in (*c*).

39. In the production of tram, it will be necessary to take precaution only in the doubling process, for the take-up bobbins of the winder are placed on the jack-pins of the doubler. The threads that are wound on the take-up bobbin of the doubler, however, are wound in a direction to allow right twist to be inserted in the thread. This, of course, is similar to that illustrated in Fig. 7 (*c*) and (*d*).

To sum up, should it be desired to insert a left twist in the thread, the bobbin on which it is to be wound should be placed on the spindle of the winder or doubler so that the head containing the large hole will be against the spindle head. Should it be desired to impart a right twist to the thread, it will be necessary to place the bobbin on the spindle so that the head containing the small hole will be against the spindle head.

40. In order to determine the direction of twist that is to be inserted in the thread wound on a bobbin, it is necessary, first, to adjust the bobbin in one hand so that it will have the same relative position that it has on the spindle of the spinner or twister. That is, the bobbin should be held upright, with the large hole of the bobbin at the bottom. The end of silk from the bobbin should be found, and drawn away in a horizontal direction. If it comes from the left side of the bobbin, as illustrated in Fig. 7 (*b*), a left twist only can be inserted in the thread while wound on the bobbin in this manner. If, on the other hand, the thread pulls from the right side of the bobbin, as in (*d*), a right twist only can be inserted.

As the bobbin revolves in the proper direction, it tends to bind the silk firmly on the bobbin. If, however, an attempt should be made to insert a right twist into a thread that was wound originally for a left twist, the centrifugal force created by the rapid revolution of the bobbin would cause the layers of silk to expand and become loose, finally resulting in a mass of silk that would be reduced to waste.

41. Selection of Supply Bobbins.—One of the first requisites of good doubling is to have the doubled threads wound on the take-up bobbin under equal amounts of tension. The importance of this may be readily understood when it is explained that when threads are doubled under unequal tension, an imperfect thread, known as a *corkscrewed* yarn, will invariably result in the succeeding operations. To avoid this as much as possible, it is necessary to wind all the threads under the same conditions. In the first place, approximately equal amounts of yarn should be wound on the winder bobbins, so that it will require about the same tension on the threads to start and keep all bobbins running. When starting the doubler, it is well to place only full bobbins on all the jack-pins. Then, during the doubling operation, one glance will show whether the operative has properly attended to the work of tying the ends; for, should a number of bobbins still contain large quantities of silk in comparison to the others, it will be known that they were not running as much as the other bobbins. This may be the result of either incompetence or defects in the silk or the winding.

42. Redoubling Raw Silk.—Occasionally, but at very great intervals, a throwster is called upon to redouble a lot of raw silk that has been doubled at some previous time. For example, suppose that a weaving mill is running a quality of fabric that calls for two ends of silk without any twist, and that after the material has been woven, a large quantity of the untwisted 2-thread silk remains for one reason or another; then it is decided that the surplus is to be employed in some other fabric that may employ a 4-thread tram. The lot of doubled raw silk is sent to the throwing mill with instructions to double it into a 4-thread tram. This, of course, may be accomplished with ease, for the bobbins holding the two threads may be placed on the jack-pins of the doubler and doubled on one bobbin, which is then prepared to be sent to the twister for the insertion of the twist. When the bobbins holding the doubled silk have equal numbers of threads properly doubled, no more trouble should be encountered than when doubling four single ends of raw silk from four separate bobbins and then inserting the twist. However, should the instructions be that the throwster redouble the 2-thread into a 3-thread tram, using a single end of raw silk of an equivalent quality and size to the singles in the doubled thread, the raw silk for the single end being received in bale form, it will be necessary to employ a different method in redoubling the silk to insure a smooth and evenly laid thread.

43. When a thread as just described is to be thrown, it is necessary to wind the skeined silk on bobbins so that it will be in the proper form for use on the doubler. The next step is to wind a doubled thread and the single thread on a spinner bobbin. It should always be remembered that, because of the elasticity of the raw silk, when redoubling from two bobbins where one has a single end while the other has a double end, the single end would be stretched, because the strain placed on it is proportionately greater than the strain placed on the doubled thread. The result of doubling in this manner is that after the tension is released from the threads, the single end springs back or shortens and becomes tight, while the two remaining threads become slack and probably will form loops in the succeeding operation, thus resulting in a defective thread.

In order to avoid the foregoing defect, sufficient friction must be placed on the double threads so that the tension on them will equalize that of the single end. Then after the threads are wound and the tension is removed, all will shorten an equal amount. The proper tension on the threads may be obtained by placing the bobbin holding the single end on the top pin of the vertical doubler; the bobbin containing the two ends is placed on the bottom pin in the same row and two empty bobbins are placed on any two adjoining pins in the same row between the winder bobbins. The double end is brought up back of the one empty bobbin, between the two bobbins, and up in front of the second empty bobbin. Then the single end is passed through one drop wire and the doubled end is passed through a second drop wire and both are wound on the take-up bobbin. In this way additional tension is applied to the doubled thread while no tension is added to the single end.

44. Since the speed of the frames, the weight of the bobbins, and other elements enter into the consideration of tension, it is impossible to specify a tension that will be correct in all cases. The correct tension must be found by experiment. Therefore, two or three bobbins should be started at first and after doubling a few yards the bobbins should be stopped and the tension of the threads tested by removing the doubler bobbin from the frame, and unwinding 2 or 3 feet of the redoubled thread, pulling it from the side of the bobbin, thus keeping the same conditions as when it was wound. A length of the thread is suspended between the two hands and allowed to sag slightly in the middle and then the thread is tightened slowly by moving the hands apart, while the length of thread is carefully examined to see if the three threads become taut at the same time. If, the first time the thread is tested, the slack is taken up in the single thread more quickly than in the doubled thread, the tension on the double end should be increased, and the doubled end may be passed completely around one of the empty bobbins used to increase the tension of the thread.

45. After the tension on the doubled end has been readjusted, the thread should be tested again. If, when the threads are slowly stretched the slack is taken up in all three threads at the same time, the whole doubling frame may be started on the work and the tension on all bobbins may be adjusted in the same manner as for the first one described.

Redoubling may be satisfactorily accomplished on a downspinner, but requires more care. However, in placing the bobbins on the jack-pins, the bobbin with the single end should be placed on the bottom pin and the bobbin with the doubled silk placed above it with the two empty bobbins between.

From this description, any other redoubling, not a multiple of the first doubled thread, should be arranged in this manner, and the threads should be tested for tension from time to time, as uneven tension in doubling produces bad work in the twisting operation.

SIZE, POWER, AND SPEED

46. Size of Doubling Frames.—Doubling frames are regularly built with 60 spindles on the 6-end frame and 50 spindles on both the 8-end and the 10-end frame; that is, a 60-spindle doubler is equipped with 30 spindles on each side of the frame. The dimensions, except the height, of both frames are the same, being 17 feet 2 inches in length and approximately 2 feet 2 inches in width. The height varies, because the greater the number of bobbins supported on the jack-pins attached to one pin-rail, the higher will be the frame. Thus, the 60-spindle frame, being a 6-end doubler, will not be as high as the 8-end or 10-end frame, the height of the former being 3 feet 9 inches and of the latter 4 feet 1 inch. Although doublers are ordinarily built in the sizes that have been mentioned, they are also built longer or shorter according to the floor space available in the mill, or according to other requirements. Needless to say, the size of the doubler governs its weight. The average weight of a doubling frame when crated and ready for shipment is approximately 1,200 pounds. This is the representative weight of the 6-, 8-, and 10-end doublers of standard spindle capacity, the larger sizes increasing proportionately in weight.

47. Power and Speed.—Slightly more power is necessary to operate a doubler than a winder, but this is to be expected; for, instead of turning only one swift per spindle, as in the case of a winder, up to ten bobbins must be turned, depending on the size of the frame and the number of threads to be doubled. An ample amount of power necessary to operate doublers successfully with a variable load would be approximately $\frac{1}{4}$ horsepower for two 50-spindle frames, or 100 spindles.

To obtain good work from the doubler, it is imperative that the machine be run at a moderate speed. When it is run at a high speed, the bobbins on the jack-pins are likely to run with a jerky motion, so that the threads that are wound on the take-up bobbins will be under uneven tension. One of the greatest reasons for this high speed is the lack of a sufficient number of spindles to double adequately the threads from one or more machines in preparing them for the twister. Consequently, it will be necessary to increase the speed of the machine so that it will produce the required amount of thread which, however, is conducive to poor work. To eliminate it, the doubler should either be provided with a suitable number of spindles, or a sufficient number of machines should be supplied to meet the demands placed on them. This will result in better twisting, as poor doubling usually produces poor twisting.

A moderate speed for the line shaft is from 165 to 175 revolutions per minute. With the line shaft equipped with a three-step cone pulley, variations in speed may be obtained to meet the requirements of the throwster. With the stated line-shaft speed and the proper combination of pulleys, the speed of the take-up shaft may be varied from 110 to approximately 262 revolutions per minute. This range of speed, together with an ordinary spindle, will turn the take-up bobbins at the correct speed to give a suitable thread speed.

48. Reducing Friction and Wear.—As with any other machine in the throwing mill, correct lubrication of all parts of the doubler subject to wear will greatly prolong the life of the machine and reduce the power required. It is very important that the bevel and spur gears, as well as the cam follower and the face of the cam, be kept well lubricated. All accumulations of waste silk that become twisted on the take-up shafts, especially close to bearings, should be removed in order to prevent any binding and straining of the parts. The cam follower should also be inspected to see that it presents a new face to the cam after every throw of the traverse bar. It is well to oil the fingers that support the spindles, as this will increase both the smoothness with which the spindle revolves and also its life.

VARIATION IN DOUBLER CONSTRUCTION

49. Another doubler that is used to a great extent may be briefly described at this point. In construction it differs slightly from the doubler just described, but its method of operation is the same. The end stands and the middle stands are connected by flat iron bars instead of by pipe ties, and the iron bars are attached to the stands by angle irons. Supported directly above the drop wires are porcelain rollers that help to steady the thread by increasing the friction. In the construction of the stop-motion, the faller that is employed is slightly different. Instead of obtaining the final adjustment by means of a small lead weight, as previously illustrated, the faller and its bracket are placed in a testing support and the faller is tested for balance when the machine is constructed. If it does not balance, but moves to one side, it is ground down until it balances properly, after which it is attached in its proper position in the doubler frame and should require no further adjustment.

SPINNERS

FIRST-TIME AND SECOND-TIME SPINNING

50. First-Time Spinning.—The sequence of operations in a silk-throwing mill is determined entirely by the class of yarn to be thrown. Since some processes are applied to one class of yarns that would not be applied to another, a distinction in the throwing operations may be made. As already described, the two great classes of thrown-silk yarns are organzine and tram, and because of differences in their manufacture they may be used as examples.

After the winding operation, the single end of commercial raw silk that is to be used in the manufacture of organzine is placed on a machine that is termed the *first-time spinner*, or simply the *spinner*. The object of the first-time spinner is to twist the thread on its own axis, usually at a very high speed, thus inserting a predetermined amount of twist according to the combination of twist gears used. The term spinner, as used here, should not be confused with the term spinner employed in the cotton industry and other industries in which the shorter fibers are spun into thread. While both machines are given the same name, their construction and method of operation differ to a great extent.

51. In cotton and related machinery, the short fibers are drawn out or drafted by the action of drawing rolls, and then the fibers are spun into a thread by the rapid revolution of the spindle holding the bobbin on which the yarn is being wound. The spinner as used in the silk industry is not equipped with drawing rolls, since these are unnecessary when spinning fibers of this length. Since the silk fiber is composed of a continuous strand, the drawing out or drafting would result in the breakage of the strand and render it unfit for a thrown-silk yarn. Hence, the silk spinner, as employed in a throwing mill, is a machine which inserts a definite number of turns of twist in a raw-silk single.

The results of first-time spinning are the twisting of the raw-silk single, and the better union of the individual cocoon ends, thus increasing the strength of the thread. This is always done when manufacturing an organzine thread. Likewise, thrown singles are produced on a spinner, a varying number of turns of twist per inch being inserted in the thread according to the specifications given to the throwster by the customer. It may be stated here, that a left-hand twist is usually inserted in the thread on a first-time spinner, unless a different effect is specifically stated.

52. Second-Time Spinning, or Twisting.—In many instances it is desirable to unite several ends that have received a first-time spinning and twist these in an opposite direction to the twist inserted in the first-time spinning. This is the method employed in producing organzine. In a like manner, several raw-silk singles are united, without the preliminary first-time spinning and twisted, as is usually the case, in a right-hand direction, producing a tram thread. This operation is accomplished on what is known as a *second-time spinner,* or *twister,* and is usually referred to as *twisting.* Besides this expression, the term *match twisting* often replaces that of second-time spinning, for, when an end breaks during the twisting operation, the twisted end on the take-up bobbin is found, whereupon it is untwisted to determine the number of ends it contains. The ends are then found on the spinner bobbin, and after each is found to have the same number the groups are tied. Thus, the term *matching* originated, since the ends are matched before tying and proceeding with the twisting operation.

The second-time spinner, or twister, is employed in the production of organzine, tram, crêpe, and other threads. In construction it closely resembles the first-time spinner, differing only in a few minor details, and its operation is practically the same. However, one important variation that characterizes the twister, is the use of a device known as a *flyer* when the twisting operation is performed. The flyer consists of a small wooden block to which a bent wire guide is attached. The block is placed on the spindle and rests on the bobbin. The threads passing from the bobbin are guided through an eye formed by a loop in the wire and thence upwards to the take-up bobbin. The flyer thus acts as a guide to prevent the silk from coming in contact with the bobbin head; also, the guide retains the ends of silk in a group, as they were doubled. They should be drawn from the bobbin in this manner; otherwise the ends will separate, become lapped, and break.

TYPES OF SPINNERS

53. Up-Spinners and Down-Spinners.—In the operation of spinning, doubling, and twisting, various methods are employed by different throwsters. For instance, in mills in which the older type of machinery is in use, the operations are quite different from those in mills in which the newer combination machines are employed. In spinning on the older types of machines, it is necessary for the thread to pass upwards from the spinner bobbin to the take-up bobbin; hence the term *up-spinning* is often employed. On the other hand, several combination machines are constructed so that the thread passes downwards to the take-up bobbin from the bobbins holding the silk. For this reason, the term *down-spinning* is applied to machines of this type. Since up-spinners are being built and are used to a great extent, a thorough description of this type of machine will be given first.

54. General Classes of Up-Spinners.—Up-spinners may be divided into two classes depending on their construction. The older type employed a long tin cylinder extending the length of the machine which acted as a large driving pulley, or drum, for the spindles. Each spindle was driven individually by a cotton spindle band that passed around the tin cylinder and spindle whorl. Because of this method of driving the spindles, the spinner became known as a *band-driven spinner.* The bands, however, were easily affected by weather conditions and stretched or shrunk according to the humidity of the atmosphere and hence it was necessary to adjust and renew the bands repeatedly. Because of these difficulties, the machines were gradually improved, resulting in the perfection of the *belt-driven spinner,* which is almost entirely employed at the present time.

The method of operation to be described here in regard to the passage of the thread on the various machines, is known as the *single-process method.* This name is derived from the fact that only one operation is performed on one machine. In producing an organzine thread, for example, the silk must be worked on three separate machines, namely, the first-time spinner, the doubler, and the second-time spinner. In a like manner, two machines, the doubler and the twister, must be employed in the manufacture of tram. Of course, there are other machines to complete the throwing operations before the silk leaves the mill, but they will be described in the proper order.

55. Distinction Between First-Time and Second-Time Spinners.—The terms first-time and second-time spinner have been referred to frequently. While both machines are of the same general construction, only a slight difference exists whereby one machine may be distinguished from the other. For this reason, a description of one machine and the differences in construction will suffice for both machines. In the first-time machine, which is employed when it is desired to spin the thread, the operation may be performed without the aid of a flyer. This, of course, allows the machine to be designed with the spindles closer together, since only a reasonable amount of clearance is required between the bobbins when they are in place on the spindles. The second-time machine is constructed with a larger space between the spindles to allow the use of a flyer. Besides, the thread twisted on a second-time machine is always heavier than the thread twisted on a first-time machine; hence, it has a tendency to fly away from the bobbin. This is caused by the rapid revolution of the spindle holding the bobbin.

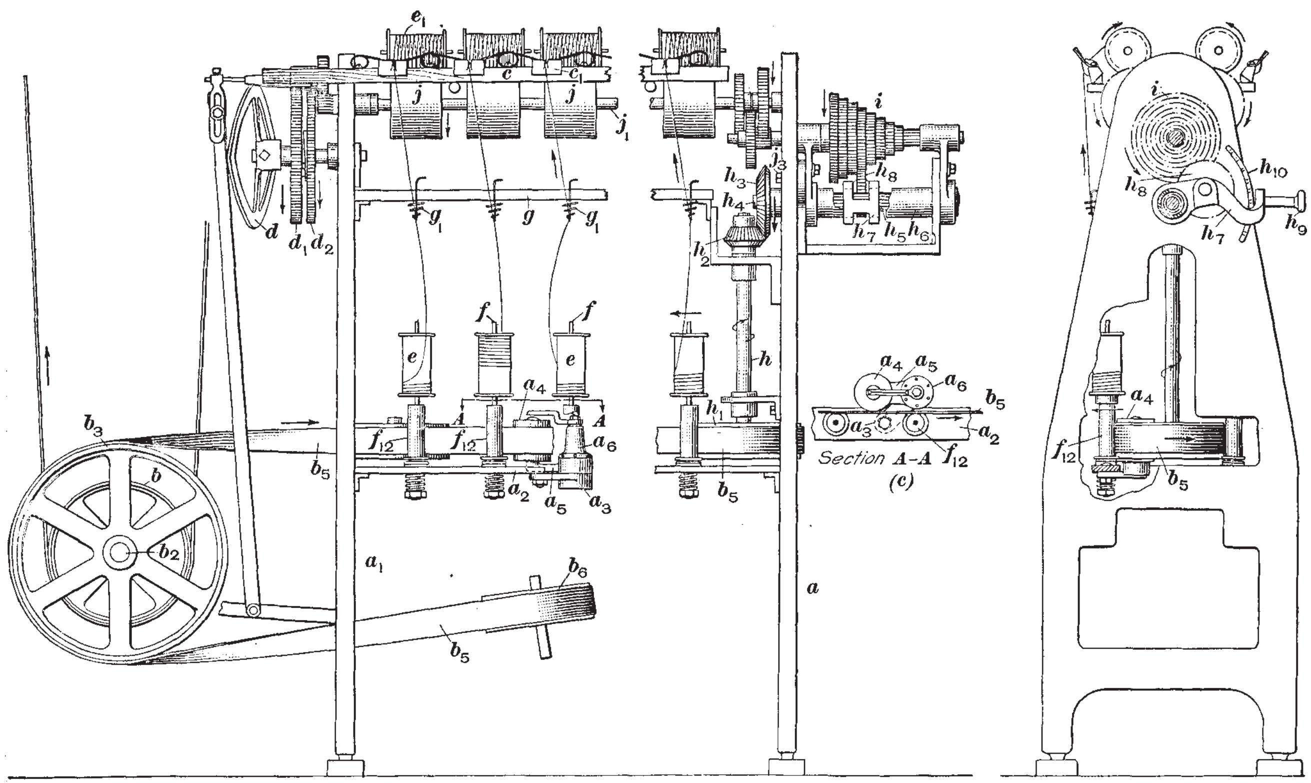
56. In mills in which organzine only is being manufactured or in which the greater number of orders are for this class of yarn, or a yarn that requires a twist inserted in the single thread, it is customary to employ first-time spinners for the first spinning, and second-time spinners for the twisting operation. This is done because the first-time machine requires less floor space for the same number of spindles than the second-time machine; for, the spindles of the first-time machine are spaced $3\frac{1}{2}$ inches apart, while the spindles of the second-time machine are $4\frac{1}{4}$ inches apart. The width of the take-up rolls varies also, the rolls on the first-time machine measuring $2\frac{1}{4}$ inches in width while the rolls on the second-time machine measure $3\frac{1}{16}$ inches.

Many mills, instead of employing first-time and second-time machines, use only second-time frames for both operations. While it is true that a slightly greater floor space is required for machines of this type, the fact that they may be used for any class of work should not be overlooked. Thus, should the tendency of the trade be for crêpe fabrics, it will be necessary to throw crêpe yarns, which is usually accomplished on second-time frames. But, if they are properly thrown, the process could be done on first-time machines, although not so cheaply and not so efficiently. Another point that is important is that when only second-time machines are employed, it will be necessary to have bobbins of only one size for all machines. If, on the other hand, first-time and second-time machines are employed, two sizes of bobbins will be required, since the take-up rolls of the first-time machine are narrower than those of the second-time machine.

CONSTRUCTION AND OPERATION OF SPINNERS

57. Principal Parts.—In Fig. 8 (*a*) is a side elevation of a type of spinning frame or spinner commonly employed for manufacturing yarns by the single-process method. The end stands a and a_1 support the various parts of the machine. The end stand a_1 supports the driving mechanism, of which only the tight driving pulley b, mounted on the crosshead shaft b_2, and the tight spindle-belt pulley b_3 may be seen in the illustration. In addition, the crosshead shaft carries a loose drive-belt pulley, and also a loose spindle-belt pulley, but these cannot be seen, due to their location. The tight spindle-belt pulley b_3 carries the spindle belt b_5, and the latter runs along one side of the machine. When in operation it imparts motion to the bobbins e that are supported on the spindles f, naturally causing their revolution. At the foot end of the machine, the spindle belt imparts its motion to the vertical shaft h by driving the pulley h_1 attached to the lower end of the shaft. The motion is transmitted through various gears, including the twist change gears of the i series, to the take-up rolls j. The latter are mounted on the take-up roll shaft j_1.

58. Passage of Thread.—As on other silk-throwing machines, the spinner is constructed so that many parts on one side are duplicated on the other, thus permitting the yarn to be processed on both sides of the machine. The bobbins e, Fig. 8 (*a*), as received from the preceding machine are placed on the spindles f and the thread is passed upwards, being pulled over the head of the bobbin. Located above the bobbins is a wooden rail g, known as the guide rail, which supports the tension wires g_1 around which the thread is wrapped in order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c
c1
j
j1
j3
d
d1
d2
g
g1
f
e
a4
a5
a6
a2
a3
A
f12
b
b2
b3
b5
b6
a1
a
h
h1
h2
h3
h4
h5
h6
h7
h8
h9
h10
i
Section A-A

(a) (b) (c)

Fig. 8

that it may receive the proper degree of tension. From the tension wire the thread is guided to the take-up bobbin e_1 by passing over the porcelain guide c_1 held to the traverse bar c by wire bows.

When the machine is in operation, the revolving take-up rolls j will cause the take-up bobbin e_1 to revolve, since the latter rests on the roll. While the bobbin is revolving, it will take up the silk at a predetermined speed, and since the bobbin e is located on the rapidly revolving spindle f, a definite amount of twist will be inserted in the thread. While the thread is winding on the bobbin, it must be given a traverse motion so that it will be evenly distributed between the bobbin heads. This is accomplished by the traverse motion given to the traverse bar c, the motion being caused by the revolution of the cam d.

59. In the preceding paragraphs, the principal parts of the spinner were pointed out, and the passage of the thread from the bobbin on the spindle to the take-up bobbin was indicated. Since this description was intended only to outline briefly the principal parts, they will later be given a more complete description. The spinner, although more complicated than the machines thus far described, is not difficult to understand. One feature, however, that differs from the machines already described is that a prescribed number of turns of twist are inserted in the thread during its passage from bobbin to bobbin, which is, of course, the object of the machine.

60. Drive of Spinner.—A top view of the pulleys in the driving mechanism of a spinner is given in Fig. 9. The tight drive pulley b and the loose drive pulley b_1 are mounted on the crosshead shaft b_2 between the spindle-belt pulleys b_3 and b_4. Of these, the pulley b_3 is known as the tight spindle-belt pulley, or spindle-belt drive pulley, since it is cast integral with the tight drive pulley b. The opposite pulley b_4 is known as the loose spindle-belt pulley, since it revolves loosely on the crosshead shaft. The crosshead shaft that supports the entire pulley assembly is rigidly held by brackets, not shown, that are bolted to the end stand and also attached to the floor. The crosshead shaft is stationary at all times. The pulleys b and b_3, cast in one piece, are fitted with self-alining ball bearings so that they may freely move on the shaft. The loose spindle-belt pulley b_4 is fitted with ball bearings in a corresponding manner so that high speeds may be maintained for long intervals without vibration or undue wear. The loose pulley b_1, however, is not equipped with ball bearings, but is merely fitted with a bushing. The object of this construction is evident for the loose pulley b_1 is employed only for a short time when starting and stopping the frame.

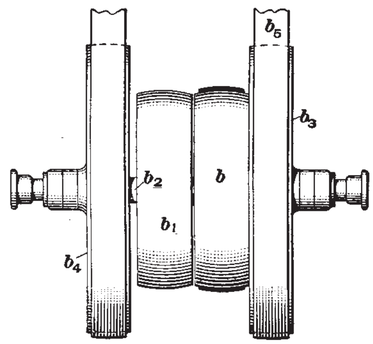

FIG. 9

61. Because the pulleys b and b_3 are in one piece, shipping the drive belt from the loose pulley b_1 to the tight pulley b will start the frame. Since the frame operates at a high speed when in motion, the bearings should always be supplied with a good grade of grease. This is injected into the bearings through grease cups located at the ends of the crosshead shaft. The grease is forced, from the cups, through holes in the shaft and directly to the bearings. Fig. 8 (a) is a side view of the spinning frame showing the positions of the driving pulleys in relation to the other parts of the machine. The tight spindle-belt pulley b_3 carries the spindle belt b_5 that runs the entire length of the frame and is in constant contact with the spindles f on one side of the frame; it then passes around the pulley h_1 attached to the vertical shaft h at the opposite end of the machine, returns on the opposite side of the machine, and drives the spindles on that side. The belt then passes around the loose spindle-belt pulley and under the frame to the movable idler b_6.

62. Tension of Spindle Belt.—The spindle belt on the spinner is usually made of leather. The point where the ends of the belt are joined and cemented is designated as the splice. It is very important that the thickness of the belt at the point of splicing be the same as in the remainder of the belt. Should the splice be too thick, it will tend to cause the spindles to be thrown away from the belt, and the spindles will jump. This condition should not exist, for a jumping spindle will produce irregular twist in the yarn. After the frame has been in operation for some time, the belt will become slack by stretching. When this occurs, the efficiency is decreased, and, to retain the

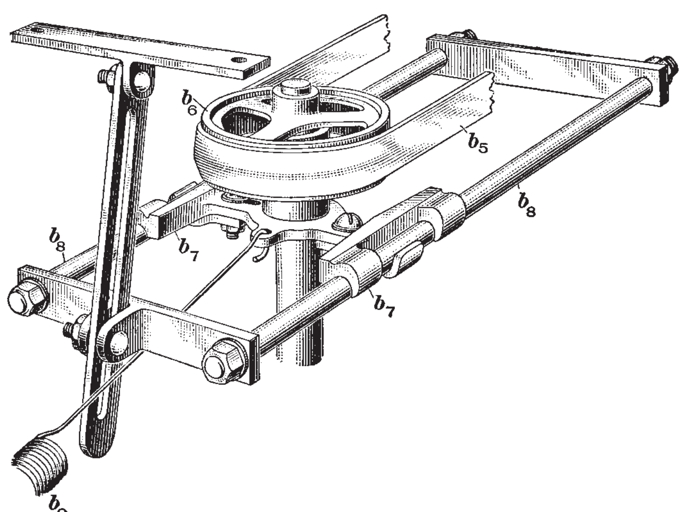

FIG. 10

proper tension, it is necessary to adjust the belt frequently. To eliminate cutting and resplicing of the belt, an arrangement is attached underneath the spinning frame to take up automatically any looseness or slack that may develop in the belt.

63. As illustrated in Fig. 10, the spindle-belt take-up mechanism consists of an idler b_6 around which the spindle belt passes after leaving the spindle-belt pulley. The idler is mounted on a shaft that turns in a ball bearing supported by the movable spider b_7. The spider is free to slide on the two rods b_8 attached to an adjustable support at one end and to the end stand at the other. A spring b_9 is attached to the spider.

and the other end of the spring is held to the frame by a thumbscrew. By turning the thumbscrew, the pull of the spring, and consequently the tension of the spindle belt may be altered as required.

64. Supply Bobbins.—The supply bobbins *e*, Fig. 8 (*a*), on the spindles *f* are received from the machine in the preceding process, in which they acted as take-up bobbins. For this reason they need not be described in detail here, as a description of them has already been given.

65. Spindles.—The spindles form one of the most important parts of a spinner or twister, and on them depends to a great extent the successful and economical operation of the spinning or twisting frame. The spindles are mounted on a long iron rail known as the spindle rail, one being located at each side of the frame, and the spindles are driven by direct contact with the spindle drive belt. The spindles used on silk-throwing machinery may be divided into two classes, or groups, namely, *rigid spindles* and *swing spindles*. Both types have given satisfactory service in many mills, and the purchaser of the frame may choose the type of spindle with which it is to be equipped. The decision as to the type of spindle depends largely, of course, on the experience of the throwster purchasing the machinery. It has been stated that rigid spindles produce a superior quality of work, since the spindles do not jump like swing spindles; again, it is said that a greater number of swing spindles can be kept in operation by one attendant than spindles of the rigid type. The choice is purely a matter of opinion and will be entirely dependent on a knowledge of the qualities of each spindle.

66. The rigid spindle will be described first, since the spindle proper that is employed in the swing spindle is a rigid spindle supported in a swinging gate. This construction merely results in a variation in the method of attachment of the two types of spindles to the spindle rail. The rigid spindle is attached directly to the spindle rail and in such a manner as to allow a slight movement. With a swing spindle, the rail step is first attached to the spindle rail, and since the spindle is supported in a swing gate that in turn is pivoted on the rail step, its swinging motion is arrested by the use of a spring that causes the spindle to bear with sufficient pressure against the spindle belt.

When a frame is equipped with rigid spindles means must be provided to retain the belt in proper contact with the spindles. This is accomplished by the use of swing idlers that press the belt against the spindles, since in this case the spindles cannot follow the belt. On frames equipped with swing spindles it is customary to provide stationary idlers bolted in place, which hold the belt and prevent it from sagging on account of slackness or the pressure of the spindles.

The stationary idler requires no further description, as it is only an idler bolted to the frame; but the swinging idler, which is slightly more complicated, will be described. The spinning frame illustrated in Fig. 8 (*a*) is equipped with rigid spindles and swinging idlers. The idler bracket a_3 is firmly attached to the spindle rail a_2 by a bolt and cannot move. The idler pulley a_4 is attached to the swinging arm a_5 which, by means of a spring in the holder a_6, maintains a constant pressure on the spindle belt b_5, holding it against the spindles. In (*c*) is a top view of the section *A-A* in (*a*) showing the position of the swinging idler in relation to the spindles. The number of idlers employed on a frame depends on the number of spindles, each idler being so placed as to press the belt against two spindles.

67. A vertical section of a complete rigid spindle is shown in Fig. 11 (*a*). The spindle blade f is a long, slender shaft of high-carbon steel that rotates in a cast-iron socket f_1 called a bolster. The bolster passes down through the spindle rail a_2 and the coil spring f_2 and is held in place by the nut f_3. The lower end forms the bearing f_4 for the lower end of the spindle blade and is called the spindle-blade step. The upper end supports the blade and forms a bearing in which it turns. The lower tapered end of the spindle blade is slightly more than 2 inches long and between it and the wall of the socket is a

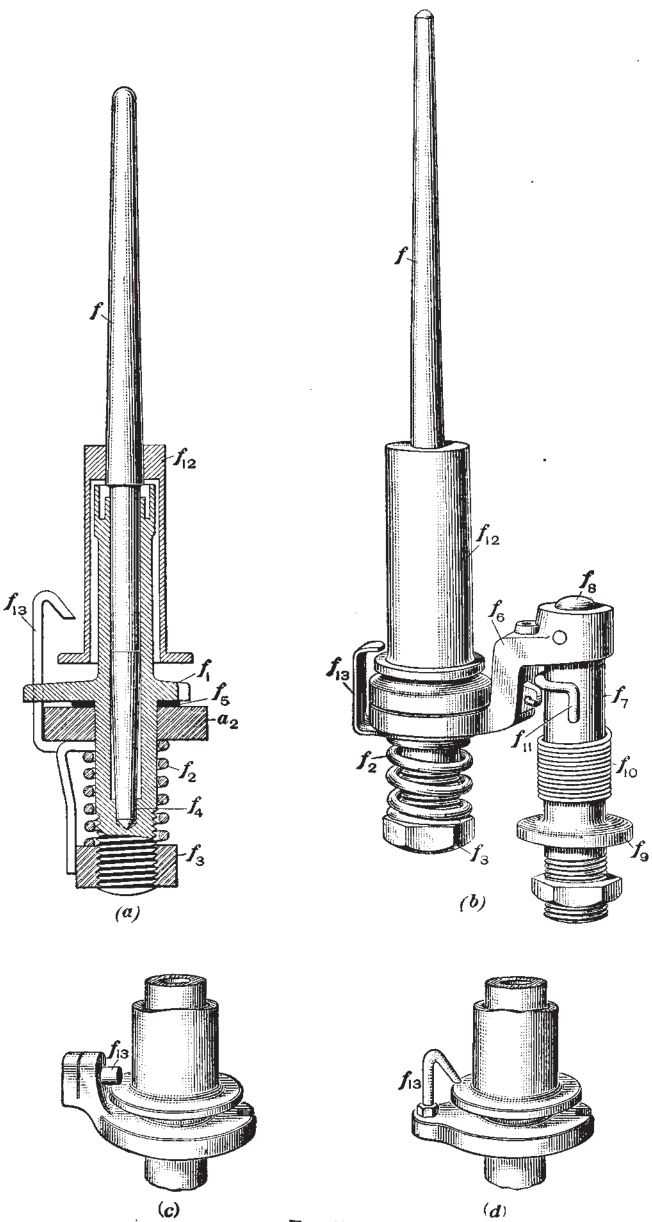
f
f_{12}
f_{13}
f_1
f_5
a_2
f_2
f_4
f_3
(a)
f
f_{12}
f_8
f_6
f_{13}
f_7
f_{11}
f_{10}
f_2
f_3
f_9
(b)
f_{13}
(c)
f_{13}
(d)

Fig. 11

space that forms an oil well. Oil injected into this well lubricates the spindle blade in the step, and while the blade is revolving the oil passes upwards between the blade and the socket. When the oil reaches the widest part of the blade it is thrown away by the centrifugal force created when the spindle is in motion and returns to the oil well through a groove in the socket casting.

68. Most spindle sockets are made of cast iron, and as this material wears more rapidly than high-carbon steel, the life of the socket is shorter than the life of the blade. When the cast-iron socket becomes worn so badly that it must be renewed, it is scrapped, since it cannot be repaired. Sometimes, spindles are manufactured with a bronze bushing in the sockets. The bushing furnishes an excellent wearing surface, and should it become worn in the course of time, it may be renewed without renewing the socket. Besides the spindles described, another type is sometimes employed, equipped with two sets of ball bearings in each socket. The advantages claimed for this type of spindle are less vibration, higher spindle speeds, and less power consumption.

69. As shown in Fig. 11 (*a*), the socket does not rest directly on the spindle rail, but against a felt washer f_5. The washer is first placed over the threaded part of the socket, which is then inserted in the hole in the spindle rail. The spring f_2 is next placed over the part of the socket extending through the rail, and the nut f_3 is screwed on. When the spindle is in operation, the washer acts as a cushion between the iron parts, reducing the vibration and relieving a considerable amount of strain on the various parts of the spindle. The spring between the spindle rail and the nut f_3 is important. It permits the spindle to be held in proper relation to the belt, but at the same time it may wobble or move slightly when sufficient pressure is placed on it; for, the hole in the spindle rail is slightly larger than the socket and only the pressure of the spring holds the spindle in position. With this construction, the spindle can find its best center of rotation within certain limits, thus reducing the liability of excessive vibration and wear. If the spindle were rigid, the vibration would cause the bobbin to loosen from the spindle, rise, and fly off. Hence, the nut f_3 should not be drawn up so tightly that the coils of the spring touch in any part, as this would be equivalent to fastening the spindle tightly to the rail and thus defeat the object of placing the spring at this point. Besides, the spindle, mounted as described, allows some bending of the spindle and socket when the bobbin is being removed; otherwise, the spindle blade would be subjected to considerable strain. When the operative removes a bobbin from a spindle, the bobbin is not lifted vertically from the spindle but is usually pulled toward the operative, and this would place a considerable stress on the spindle if it were mounted rigidly.

70. As illustrated in Fig. 11 (*a*), the socket extends upwards into the whorl f_{12}, which is that part of the spindle in contact with the spindle belt. The whorl is made of cast iron and may be considered as a small pulley; but, instead of being driven by a belt passing around it in the usual manner, it is driven by the contact of the spindle belt with a comparatively small surface of its face. It has a lip or extension at the base, which comes in contact with the spring-steel lock or hold-down f_{13} when the spindle is raised. Hence, in removing a bobbin from the spindle, the tendency will be to lift the spindle; but its removal from the socket is prevented by the hold-down.

Above the whorl f_{12}, Fig. 11 (*a*), the spindle gradually tapers to a smaller diameter than at the top of the whorl. One form of spindle, however, has a portion of the blade near the upper end ground away, for which reason it is often referred to as a *ground spindle*. The ground portion measures about $2\frac{1}{2}$ inches in length and has a smaller diameter than the remainder of the spindle. The small diameter of the upper part of the spindle is sometimes desirable when it is necessary to employ small, light-weight flyers with fine silks, so as not to cause a large amount of drag on the thread.

All the spindles on a machine should have the same size of whorl. The whorls are usually made in two sizes, one having a 1-inch diameter, while the other has a $\frac{13}{16}$-inch diameter. By using a whorl of the smaller diameter, the velocity of the spindle belt may be reduced and still obtain the same number of revolutions of the spindle. However, since the smaller whorl has less surface in contact with the belt, there is likely to be more or less slippage. Any slippage reduces the speed of the bobbin and consequently the twist per inch being inserted in the thread.

71. While the 1-inch spindle whorl may operate with less slippage, it will be necessary to run the spinner at a higher speed in order to obtain the same spindle speed as on a frame equipped with the $\frac{13}{16}$-inch whorl. The necessity of running the spinner at the higher speed also results in a corresponding increase of power consumed, which, on the 108-spindle spinner, varies from $\frac{1}{5}$ to $\frac{1}{10}$ horsepower, and should be taken into consideration when determining the horsepower required.

72. A typical swing spindle is shown in Fig. 11 (*b*). The spindle proper is exactly like the rigid spindle except that it is mounted on a movable bracket f_6, known as a swing gate or swinging holder. The swing gate is made of cast iron and is held by the casting f_7, commonly known as the rail step, so that it swings in an arc that has the pin f_8 as its center. The gate is free to swing in either direction, the pin f_8 turning in the rail step. Since the spindle moves back and forth while in motion, the pin f_8 should be lubricated, as a slight amount of wear occurs at this point. An oil hole is located near the pin f_8. The spindle is mounted in the swing gate in the same manner as it is mounted in the spindle rail; that is, a felt washer is placed over the threaded part of the socket, the socket is set in the hole in the swing gate, and the spring and the nut are attached. All precautions given in connection with the rigid spindle in regard to the washer, spring, and nut, hold true in the case of the swing spindle. When attaching the swing spindle to the spindle rail, the threaded part of the rail step f_7 is inserted in the hole in the spindle rail, and the flange f_9, resting on the rail, is held in the proper position while the nut is placed on the threads and tightly screwed in place. Thus, the rail step will be rigidly held against the spindle rail.

73. The swing spindle is free to swing with the swing gate f_6, Fig. 11 (*b*), but before the nut holding the rail step is tightened, the spindle should be swung so that the tendency of the spring f_{10} will be to pull the spindle against the spindle belt. The end of the spring f_{10} is hooked through a small lug cast as part of the swing gate f_6. The lug extends toward the rail step f_7 and only a slight clearance exists between it and the extension f_{11} on the rail step. The function of the extension f_{11} is to prevent the swing gate from being lifted when a bobbin is removed from the spindle. Also, the vertical part of the extension f_{11} acts as a stop and prevents the operative from pulling the spindle too far away from the belt. The extension, while it causes the swing gate to be held in place, is also designed to allow the easy removal of the swing gate and pin from the rail step. This is accomplished by loosening the nut holding the rail step to the spindle rail, then turning the rail step around so that the end of the extension f_{11} will clear the lug. The extension extends about halfway around the rail step.

74. There are slight differences in the methods of holding the whorl and the spindle blade in the socket until it is desired to remove them. The part performing this duty is known as the hold-down, or spindle lock, and is shown at f_{13} in Fig. 11 (*a*), (*b*), (*c*), and (*d*). In (*a*), a single piece of tempered steel wire of the same size as that used for the spring f_2 is bent into a hook. It passes around the socket and then is bent downwards, coming in contact with the nut f_3. This type of hold-down prevents the spindle from being removed from the socket unless it is desired; it prevents the socket from turning in the rail, since an extension in the flange comes in contact with the hook; and that part of the spring extending downwards and coming in contact with the nut f_3 tends to prevent the nut from loosening. When it is desired to remove the spindle from the socket it is only necessary to pull the hook with a pliers, or pry it away from the spindle with a screwdriver, so that, when the spindle blade is lifted, the lip of the whorl clears the hook. Usually the wire employed in the manufacture of the hook is of such a size that it may be pulled away from the spindle by means of the fingers. After the spindle has been removed from the socket and it is desired to replace it, the only operation necessary is to place the end of the spindle in the socket and press it downwards. The hook should be so adjusted that the lip of the whorl will force the slanting hook away from the spindle and then jump back into place after the spindle is in the proper position.

75. The lock shown in Fig. 11 (*b*) consists of a flat piece of steel f_{13} placed between the spring f_2 and the swing gate. In order to remove the spindle blade, a screwdriver or similar tool is inserted between the lock f_{13} and the swing gate f_6 and the lock is pried away. The spindle blade is then removed, and after it is cleaned or oiled as desired, it is replaced, and the lock is forced or tapped back into place.

A type of hold-down different from those already described is illustrated in (*c*). As shown, the pin f_{13} is held in the socket casting so that the part extending toward the whorl is of sufficient length to intercept the lip of the whorl as it is lifted. To remove the spindle blade and whorl, the pin f_{13} must first be pried away from the whorl, which is done by inserting a screwdriver or other flat object between the pin and the whorl. After the spindle is replaced, the pin should be tapped back into its original position.

The hold-down f_{13} in (*d*) is merely a heavy threaded wire screwed into a tapped hole in the flange of the socket and held in place by a locknut. To remove the spindle it is necessary to loosen the locknut and turn the hold-down with a pliers to allow the spindle to clear it. This operation, of course, is reversed in replacing the spindle, and the locknut must be tightened.

76. Guides.—In the passage of the thread from the spinner bobbin to the take-up bobbin, it is led through the guide g_1, Fig. 8 (*a*), directly above the bobbin. The guides are attached to a guide rail g, which is a small wooden rail, fastened to the end stands and supported at intervals along the machine. The objects of the guide are to lead the thread upwards toward the take-up bobbin and to prevent it from flying out and entangling with the ends passing upwards from adjacent bobbins.

The bulging of the thread during the spinning operation is known as *ballooning*. Because of the high speed at which the spindle revolves the thread is thrown out between the point at which it leaves the bobbin and the point at which it comes in contact with the guide, and the appearance of the thread while running has given rise to the term mentioned.

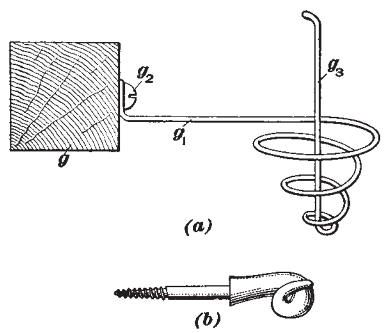

Fig. 12

There are two general types of guides usually employed on silk-throwing machinery, of which many variations are made; however, the type of guide to be used depends entirely on the operation to be performed by the machine. Fig. 12 (*a*) shows a common type of tension wire or guide. It consists of a smooth piano wire g_1 attached to the guide rail g at g_2. It is bent to form a conical spiral, with one end g_3 passing up through the center of the coil. In operation, a sufficient length of thread is drawn from the spinner bobbin so that it passes the tension wire. The bobbin is then placed on a spindle and the end of silk retained in the hand is brought in contact with the tension wire at g_1. The twisting motion of the thread caused by the rapid revolution of the bobbin compels the thread to follow the spiral and be wrapped around the center wire g_3 as many times as there are turns of the spiral. Thus, the tension of the thread is regulated by the number of times the thread encircles the center wire, which is known as the number of *wraps*. Hence, if a spiral is obtained with a greater number of turns than are found on the spirals located on the machine, the thread will be wrapped around the center wire a greater number of times and thus give a greater tension.

77. The selection of tension wires will depend, to a large extent, on the experience of the throwster. The speed of the spindle is a guiding factor in deciding the number of coils to give a certain number of wraps. Thus, with a high spindle speed it is more desirable to have fewer wraps of the thread than when spindles are operated at a lower speed. When too many wraps are made there is a tendency for frequent breakage of the thread.

A variation in the construction of a typical tension wire is found in what is termed a *drag wire*. Instead of the customary spiral around a center wire, the drag wire is merely a straight wire. In operation, the silk automatically wraps around it because of the rotation of the bobbin. The drag wire should not extend downwards too far, or the thread will be given too many wraps, causing high tension and excessive breakage. In addition to giving the required tension to the thread, it is claimed that this type of wire aids in the removal of waste that may be found on the thread.

78. The spiral tension wire and the drag wire are usually applied to the first-time spinner to give the single thread a suitable tension. The tension should not be too great, as, in spinning a single end, the silk might stretch. If stretched too far, it will lose some of its elastic qualities. When twisting two threads together, the pigtail type of guide is employed, and since a flyer is usually necessary in its operation, the flyer will furnish sufficient tension.

The second type of guide used on spinning frames, known as a *pigtail guide,* and also called a *centering eye,* is illustrated in Fig. 12 (*b*). The pigtail guide is usually made of heavy wire finished with baked enamel so that it will possess the necessary smoothness. Sometimes it is made of porcelain, having the same shape as the enameled guide. A pigtail guide is generally employed in the twisting operation since it is unnecessary to have great tension on the thread; hence, tram, second-time spinning or twisting of organzine and light-weight silks of a low twist, and crêpe and heavy-weight silks requiring the use of a flyer, employ pigtail guides on the guide rail.

When a machine is changed from a spinner to a twister or vice versa, it will be necessary to change the guides accordingly. When such changes are frequently made, the pigtail guide is usually fastened to one side of the guide rail, and the tension wire is fastened to the other. Suppose that such a machine had been used for spinning and the tension wire was used. To change it to run a thread that required the pigtail guide, it would only be necessary to reverse the guide rail and the proper guide would be in the correct place.

79. Cam and Traverse Motion.—The construction and operation of the cam used on a spinner or twister are like those of winder and doubler cams. As shown in Fig. 8 (*a*), a traverse bar *c* supports the thread guides and is given a back-and-forth motion by the cam *d*. The cam, like others previously described, is constructed with the variable motion which is necessary in the production of a satisfactory bobbin. The variable motion is produced by the gears d_1 and d_2 which have the cam follower and the cam cast integral with the inner sides of the gears. It should be noticed that the cam of the spinner is located at the drive end of the machine, which is necessary in this type of spinner, since the twist change gears *i* are situated at the opposite end and hence it would be impractical to place the traverse motion at that end.

80. Since a twister, or second-time spinner, is used in the production of many different classes of yarn, its traverse adjustments will not always be the same. This is particularly true of the high-twist yarns, such as crêpes or hard twists. In yarns of this nature, the silk, while still on the bobbins, is subjected to a steam bath in order to set the twist that was inserted in the thread in the twisting operation. It is evident that if the thread is wound on the bobbin with a slow traverse, a very compact bobbin of silk will result. It will be extremely difficult for the steam to penetrate thoroughly the layers of silk, so that the portion wound near the barrel of the bobbin will probably not be steamed. To insure thorough and rapid penetration by the steam, a quick traverse is imparted to the traverse bar, causing the silk to cross frequently instead of winding one layer almost directly over the other. This cross-winding results in a coarse traverse on the bobbin, with open diamond-shaped crossings that allow the steam to penetrate the silk with greater ease than when wound with an ordinary traverse. When it is desired to change the speed of the traverse, it is necessary to increase the size of the driving gear in the cam end of the frame, thus causing the cam to revolve with grater rapidity and increase the speed of throw of the traverse bar. This, however, does not affect the width of the traverse on the bobbin, and it is not necessary to alter the throw of the cam.

81. Gudgeons.—The take-up bobbins on the spinner are held in proper relation to the take-up rolls by short, loose-fitting steel rods known as gudgeons, or gudgeon pins. Because of the style of take-up bobbin with which they are used, two types of gudgeons are regularly constructed. They are the straight-hole gudgeon for straight-hole bobbins, and the tapered gudgeon, which is employed when a tapered-hole bobbin is used to take up the thread. A typical straight-hole gudgeon measures about $\frac{1}{4}$ inch in diameter and is about $\frac{1}{2}$ inch longer than the bobbin, so that, when it is in place, approximately $\frac{1}{4}$ inch of the pin extends from each end of the bobbin and engages with the fingers of the spinner.

The tapered gudgeon pins used in connection with taper-hole bobbins are of practically the same length as the straight-hole type. Moreover, they are similar in construction to tapered winder spindles except that they have no springs for holding the bobbin, being merely a solid tapered pin. The tapered gudgeon is thrust into the taper hole, and when deposited in the fingers, it prevents the wobbling that usually occurs when a straight pin is placed in a bobbin of this type.

82. Take-Up Bobbins.—The take-up bobbins e_1, Fig. 8 (*a*), on which the spun, or twisted, thread is wound while it is being processed on the spinner, are of practically the same size and construction as the bobbins employed on the other machines previously described. The style of take-up bobbin used depends on the type of the machine, the class of work being produced, and also on the processes or treatments the silk may receive after leaving the spinner. The bobbin used for first-time spinning on a machine equipped with narrow rolls could not be employed as a take-up bobbin on a first-time spinner equipped with wide rolls; nor could the ordinary fiber-head bobbin used on a second-time spinner be successfully used as a take-up bobbin when spinning crêpe. In the latter case, the silk is steamed while on the bobbins, and so it is important that the materials employed in their manufacture be heavier and the entire bobbin be of a more substantial construction. For instance, the take-up bobbin on a first-time spinner equipped with narrow rolls is invariably constructed with a wooden barrel and fiber head. This bobbin is also equipped with a straight hole through which the straight-pin gudgeon is inserted before depositing both bobbin and pin in the fingers of the spinner. Should the first-time spinner be equipped with wide rolls, a longer barrel will be required on the bobbin. The construction of the remainder of the bobbin will, of course, be similar to those employed on a first-time spinner with narrow rolls.

83. A variety of take-up bobbins are employed on the second-time spinner, on which the operation of twisting is performed. The selection and proper construction of this bobbin are determined to a large extent by the succeeding operation to which the silk is subjected. For example, should the silk be thrown into tram or organzine that is reeled in the following operation, a fiber-head bobbin may be employed. However, this type of bobbin is not invariably used, for, because of its light weight, it frequently slips on the take-up roll, resulting in a variation in the twist per inch. If, on the contrary, it is necessary to steam the silk, a bobbin designed to withstand the action of the hot vapor will be required.

Fiber-head bobbins having extra-heavy heads have been constructed for steaming purposes. After continued use, however, the heads become warped and loosened from the barrel. The moisture in the steam also causes the glue to become soft, and at the same time the expansion of the silk on the bobbin causes the bobbin heads to be forced from the barrel. For these reasons, fiber-head bobbins are not successfully employed for steaming purposes.

84. An iron-head bobbin, or iron-head steaming shaft, as it is frequently called, is shown in Fig. 13. It consists of a wooden barrel e_1 to which are attached the iron heads e_2. A gudgeon e_3 passes through the heads and extends about $\frac{1}{4}$ inch beyond each. The gudgeon is firmly held in place and, since it cannot be removed, it is referred to as a tight pin gudgeon. The construction of this type of bobbin varies with different manufacturers. For instance, the heads are sometimes made solid, while at other times four small holes are stamped in each head, as illustrated. The heads are also attached to the barrel in different ways, but the most common method is by means of the gudgeon, which is made with a small collar about $\frac{1}{4}$ inch from the end. It is then passed through the hole in the shaft after the heads are in place, and the whole is placed in a press. Sufficient pressure is applied so that the heads will be firmly pressed into place and the end of the gudgeon riveted. When this construction is employed, the heads are prevented from turning by driving pins through the holes in the head or by having on the inner side of the head small prongs that are forced into the wood.

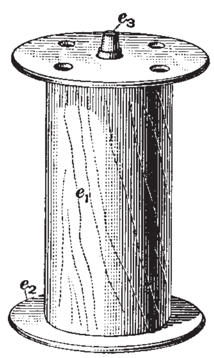

FIG. 13

Again, the heads are sometimes held in place by three rivets passing through the entire bobbin. The gudgeon employed when the bobbin is constructed in this manner consists merely of a pin of the correct length held in place by a small pin passing through the barrel of the bobbin at right angles to the gudgeon. As mentioned, the heads of the bobbin are constructed of iron, and it is very important that only a heavy galvanized iron, aluminum, or other rust-proof material be utilized for the purpose. The object of this especial care in the selection of the material for the heads is to prevent the formation of rust caused by steaming the bobbins. Should rust be deposited on the silk, it would be discolored, grow tender, and then break. In order to be doubly sure that the silk will not come in contact with the metal head and become stained and subject to deterioration, it is sometimes wound so that a space of from $\frac{1}{2}$ to $\frac{3}{4}$ inch remains between the end of the traverse of silk and the bobbin head, which effectively eliminates all possibilities of staining. In practicing this method, however, the capacity of the bobbin is reduced, which increases the frequency of doffing.

85. Sometimes iron-head steaming shafts are constructed with holes bored lengthwise through the barrel of the bobbin, communicating with smaller holes bored from the face of the barrel at intervals of from $\frac{3}{4}$ to 1 inch. When using a bobbin of this construction, the steam enters the holes in the barrel through corresponding holes in the iron heads, and thence passes through the smaller holes, coming in contact with the silk against the barrel of the bobbin.

The construction of the iron-head steaming shaft has several advantages. It requires no loose pin gudgeons and so may be doffed with greater ease and rapidity, which is very important. Also, less waste collects on the pins, and should any be found, it may be very easily removed.

86. Another type of bobbin that is frequently employed when spinning crêpes or threads that are usually steamed on bobbins is a solid wooden barrel without heads, often referred to as a barrel drum and sometimes as a roll. A straight hole is bored through the center of the barrel and in it a loose pin gudgeon is placed. When the bobbin is deposited on the spinner, the gudgeon engages with the fingers that guide the bobbin and hold it in proper driving position with the take-up roll. Sometimes the barrel is smooth and even, but at times two or three small grooves are cut around its circumference. When two grooves are used they are located about $\frac{1}{2}$ inch from each end of the barrel; should a third groove be employed, it is located at the middle of the bobbin.

The object of grooving is to eliminate the tendency of the silk to slide toward the center of the bobbin when starting and also to prevent slippage of the silk. When taking up silk on a bobbin of this type, the cam on the machine should be adjusted so that the traverse bar will be given a short but rapid throw. This gives a cross-winding effect to the thread, which is desirable; for when it is wound on a bobbin in this manner, its distribution allows a more rapid penetration of the steam. The traverse of the silk on the bobbin should be such as to allow about ½ inch of space on each side of the thread; that is, the thread should be wound between the two outer grooves on the barrel. Even though a cross-wind is employed, the quantity of silk that is wound on the bobbin should not be too great, as the penetration of the steam might be hindered. The amount wound should be such that the penetration will be thorough and the silk on all parts of the bobbin steamed uniformly.

87. While bobbins of the headless variety may be preferred by some throwsters, others prefer the ordinary iron-head steaming shaft or a solid wooden bobbin with integral heads. The reason for this preference may be explained as follows: While the take-up bobbins are revolving, ends often break, and if they are not seen within a short time by the operative, they become pressed between threads that have been previously wound, thus making it difficult to find the end. Usually, the thumb or forefinger is moistened slightly and the silk is stroked in the direction the bobbin was revolving, and if the end is not located the thread is cut. On an ordinary bobbin this is done by cutting a few ends at one end of the bobbin, adjoining the head. All the ends of the cut threads should be gathered together and gently pulled over the head of the bobbin, at the same time giving to the bobbin a slight shaking motion from side to side. Silk is pulled over the head of the bobbin until several layers have been removed and the end will usually be found. If not, the operation is repeated. With a headless bobbin this is more difficult; for, when pulling the silk in this manner, preceding layers are often started, so that a considerable amount of waste is made before the end is found. The amount of waste depends to a large extent on the skill of the operative. When headless bobbins are transferred from one department to another, the edges often become damaged and the silk is knocked loose, which causes it to unwind poorly in the following operation and increases the waste.

88. Take-Up Rolls.—The take-up rolls of the spinner and twister, also frequently called the friction rolls, may be compared to the friction wheel of the doubler, as both are employed for the same purpose, namely, to cause the bobbin to revolve and take up the silk. The method of driving the bobbin, however, is different; for, in the case of the doubler, the bobbin is driven so that the speed remains the same during the entire period of winding. Consequently, as the diameter of the bobbin enlarges, a corresponding increase in the thread speed will result. In the case of the spinner, it is of the utmost importance that the thread speed remain uniform, as any fluctuation will immediately alter the twist per inch being inserted in the thread.

A spinner is equipped with two take-up shafts, one on each side of the frame. Fig. 8 (*a*) shows the take-up shaft j_1 supporting the take-up rolls j at regular intervals. Above the take-up rolls, but not shown in the illustration, are the spindle fingers, similar in construction to those already described on the winder and doubler. In this case, however, a headless spindle or gudgeon is passed through the hole in the bobbin, and then the bobbin and gudgeon are deposited in the fingers and the bobbin is allowed to come in contact with the take-up roll. This is possible since the fingers of the machines are constructed to allow a free movement of the bobbin, either upwards or downwards, as the case may be. The object is to allow the bobbin to rise as it becomes filled and cause the number of turns of twist per inch being inserted in the thread to remain constant. Because of the manner of inserting the twist, should the take-up bobbin take up the silk more slowly at one time than at another, the twist per inch at that portion would be greater than in the remainder of the thread. When the bobbin is placed in the operating position, it comes in direct contact with the take-up roll. As the silk is wound on the barrel, the diameter will naturally be increased, which, because of the method of driving, will cause the bobbin speed to decrease, while the thread speed per minute remains the same.

89. Since the take-up bobbin is driven by direct frictional contact with the roll, it is evident that a roll covering must be provided to increase the friction between the roll and the silk and prevent the bobbin from slipping. While increasing the friction between the roll and the silk, it is very important that the material employed will not scratch or injure the silk. Exceptional care must be exercised in this respect, for silk that is injured in this or similar operations is difficult to detect until the later operation of boiling off, which precedes dyeing. The friction between the take-up roll and take-up bobbin, however, must be sufficient to produce an adequate amount of tension to cause the thread to break when it is caught or withheld in any way. This is necessary, since, if the bobbin were held by a thread, it would allow the revolving take-up roll to rub the silk in one place and cause chafed or burnt silk.

Various materials have been used to increase the friction between the take-up roll and the silk. Among the most satisfactory are cork, paper, and leather. Cork is probably most widely employed, as it possesses the qualities that are essential for a serviceable roll covering. That is, it is soft and spongy and cannot injure the silk; it also provides a very good friction surface that does not readily absorb the various substances present in the fiber, such as soap and oil. Roll coverings made of paper are also extensively used, but after continued service the paper becomes shiny and smooth, allowing the silk to slip and hence to twist unevenly. A third roll covering is leather, but it is usually employed only after treatment with a preparation intended to keep it from absorbing soap and oil from the silk. If the treatment is not applied, the soap and oil are absorbed. The roll of leather becomes saturated and then shiny, allowing the silk to slip and twist in the wrong manner.

90. The diameter of all the rolls on a machine should be the same. If the diameters vary to a considerable degree, the twist in the thread on the bobbins will probably vary sufficiently to cause a critical customer to complain. Of course, there are certain prescribed limits of variation and the throwster should remain within these. The width of the roll, on the other hand, depends on the spacing of the spindles. If, for example, a frame is employed with narrow spacing, that is, a first-time machine, the rolls will be narrow, measuring approximately $2\frac{1}{4}$ inches across the face. If the usual second-time spacing is employed, the rolls measure $3\frac{1}{16}$ inches across the face. The width of the roll governs the size of the bobbin to be used, for a bobbin with a long barrel cannot be employed on a first-time frame, and vice versa. For this reason the wide spacing all around is considered a more economical method by most throwsters.

While a frame is in operation, the rolls should be watched and any jumping or climbing of bobbins should immediately be investigated. Should any roll covers, especially cork covers, be found to have worn edges due to the climbing of bobbins that are out of true, or to bobbins that have their holes badly worn and consequently wobble while in contact with the take-up rolls, they should be covered again and the bobbins should be replaced. Those with worn edges should be especially avoided on first-time, narrow-spaced frames, for they cause the bobbins to develop ridges near the heads when winding. This results in delays in doubling. When doubling threads from bobbins traversed in this manner, there is a tendency for uneven running; for, while the thread is running from the low portion of the bobbin while on the jack-pin of the doubler, the speed of the bobbin will be slightly greater than when it is running from the higher or ridgy portion adjoining the heads. Consequently, the bobbin will have a tendency to overrun and cause a loopy thread.

91. When very heavy work is being twisted as crêpes or hard twists with a large number of turns of twist per inch, a gear take-up is sometimes employed. On a twister its purpose is to prevent any slippage of the bobbin and thus eliminate uneven twist from that source. As slippage cannot exist where gears are employed, it is also known as a *positive take-up*. A positive take-up employed on silk-throwing machinery is illustrated in Fig. 14. The spur gear j_5 is held by a setscrew to the take-up shaft j_1 Directly above, and in mesh with the gear j_5, is a spur gear j_6 that is positively driven by the gear j_5. Attached to the upper gear is a gudgeon j_7 that passes through the hole in the bobbin, while the two pins j_8 attached to the gear j_6 engage with corresponding holes in the bobbin head, thus causing it to turn when the upper gear j_6 is turned. In this way, a positive drive of the bobbin is obtained, since there is no possibility of slippage of the full bobbin while on the spindle, and also no slippage between the gears.

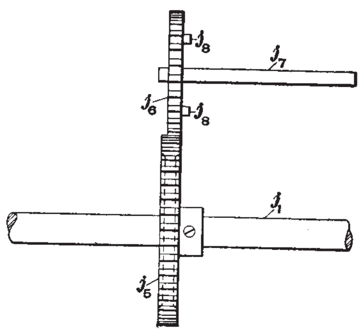

FIG. 14

92. After the bobbin is placed on the gudgeon, it is deposited in the fingers, or hangers. The gear j_6, Fig. 14, will then rest on the gear j_5 while the end of the gudgeon is held in position in a slot, the opposite end of the gudgeon being held in a small bearing, or hanger, similar to that employed on the winder. Because of the change of diameter of the bobbin while the bobbin is winding, the thread speed is changed, thus altering the twist being inserted in the thread. To equalize this unequal twist, it is necessary to pass the thread through a second operation, causing that part which was wound last, and has the least twist, to be wound first in the second operation, and consequently have a greater amount of twist inserted.

93. The bobbins used in connection with a twister that employs the gear take-up shown in Fig. 14 must be equipped with two holes that engage with the two pins on the gear j_6; or, the bobbins may have a slot cut in one head, of the proper size to engage with the pins on the gear. The gear and gudgeon are frequently equipped with piano-wire springs. When supplied in this manner, it will be unnecessary to have pins in the gear and slots or holes in the bobbin, as the wire springs should hold the bobbin in position.

94. Flyer and Button.—When it is desired to twist doubled threads together on a twister, it is necessary to employ a flyer unless other methods of procedure, to be described later, are adopted. When a flyer is employed it serves two purposes. By having the end threaded through the guide at the end of the flyer arm, the flyer produces a drag on the thread, which imparts to it added tension that prevents the formation of kinks or loops. Besides, it guides the threads from the bobbin so that they will be drawn away in a group, similar to the manner in which they were wound on the bobbin in the doubling operation. If the doubled thread were twisted without a flyer, it is possible that the group of threads would separate, causing many breaks and a considerable amount of trouble. Hence, whenever it is desired to twist on a twister two or more ends of silk that have only been doubled, it will be necessary to employ a flyer in order to insure a smooth thread.

A general reference has been made to flyers, but it may now be said that several types are manufactured to meet the needs of the many varieties and amounts of twist that are inserted in different yarns. In Fig. 15 are shown various types of flyers in common use. The figure 8 flyer shown in (*a*) consists of a circular, kiln-dried block of dogwood and a piano-wire arm bent into the proper shape. The block of wood is about $\frac{3}{4}$ inch in diameter, and through the center is reamed a hole slightly larger than the diameter of the spindle blade *f*, which allows the spindle to turn freely in the flyer. A light steel piano wire k_1 passes into the block k near the bottom, is curved upwards through the block, and bent into a semicircle k_2. Directly above the spindle the wire is twisted into the form of a figure 8, as indicated at k_3, and of which a top view is also shown. After forming the figure 8, the wire again is bent into another semicircle, passes through the block k and issues near its bottom exactly opposite the wire on the other side. The wires extend in opposite directions, and at a point about $1\frac{1}{2}$ inches from the center of the block *k* they are bent downwards parallel to the barrel of the bobbin, extending in that direction about $\frac{3}{4}$ inch. At the ends of the wires open loops k_4 are formed, similar in shape to a pigtail guide, through which the thread passes after leaving the bobbin. The pigtail both guides the thread from the bobbin and prevents the doubled threads from separating.

95. The type of flyer just described is made in a number of sizes and is usually employed when twisting heavy tram, crêpes, and artificial silk of heavy denier. When it is used on heavy grades of work, the silk does not balloon so much as when the flyer employed does not lead the silk upwards from directly above the center of the bobbin.

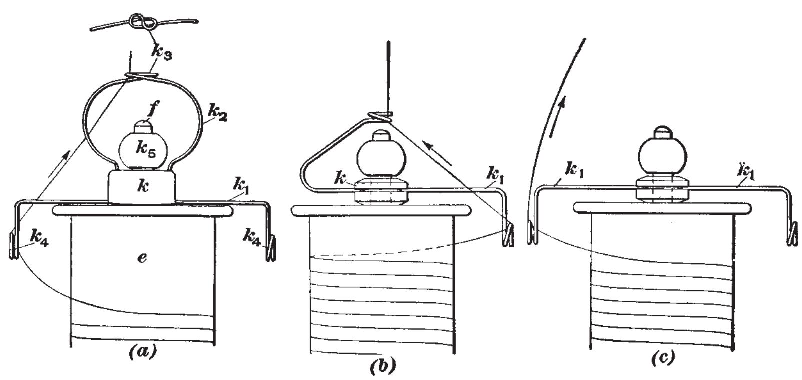

FIG. 15

Another flyer somewhat similar to the figure 8 style just described is known as the figure 4 flyer because its shape resembles a figure 4. It is illustrated in Fig. 15 (*b*). The block *k*, which holds the wire arm k_1, has a groove extending around its outer edge and the wire is bent to fit the groove, being held in place by two small pins. The wire is then bent downwards on one side of the flyer and curved into a pigtail in the same manner as in the figure 8 flyer. On the other side the wire is bent upwards and formed into another pigtail with its center directly above the spindle blade. The object of bending the arm in this manner is to guide the thread from the bobbin and deliver it in the same manner as in the figure 8 flyer.

96. Still another style of flyer that is employed when twisting the lighter silks is illustrated in Fig. 15 (*c*) and is sometimes called a drop-arm flyer. It is of practically the same construction as the flyer illustrated in (*b*); but instead of having only one arm bent downwards, two arms k_1 are bent in exactly the same manner. With this type of flyer, the thread is given a greater opportunity to balloon since it is not guided upwards as is the case with the two flyers already described. However, since this type is employed when twisting silks of finer sizes into organzine and tram, the balloon will not be so pronounced.

Flyers are made in a number of sizes and the size and weight of the block, as well as the size of the wire, vary. This is necessary because of the many different classes of work for which a flyer is employed. Hence, it is impossible to give a table stating the weight of the flyer to be employed when twisting a certain size of silk into a certain ply thread. The weight is best found by careful observation and experiment.

97. The flyer, fitting loosely on the spindle, rests on the head of the bobbin. In order to prevent it from rising and being drawn from the spindle by the action of the thread, a *button,* or *mill-nut* as it is sometimes called, is placed on the spindle after the flyer is in position. The button is a small spherical piece of wood k_5, Fig. 15 (*a*), about $\frac{1}{2}$ inch in diameter. A tapered hole about $\frac{1}{4}$ inch in diameter and corresponding to the taper of the spindle blade, is reamed through the button so that when it is placed on the tapered spindle, it may be tightly wedged in place by forcing it downwards. This will effectively hold the flyer on the spindle until it is desired to remove it.

Besides the flyers that have been described, another type that does not require a button to hold it in place, is illustrated in Fig. 16. In (*a*) is shown a part section of the bobbin *e* with the flyer in position on the spindle; a perspective view of the body k_6 is shown in (*b*); (*c*) is a side elevation; and (*d*) is a top plan view. The flyer consists of a brass body k_6, the lowest flange of which is slightly off center, or eccentric. This is clearly shown in (*a*), the low side of the eccentric being lettered k_7 while the high side is lettered k_8. The upper part of the body contains a groove of approximately the same width as the diameter of the wire k_1. Two pins k_9 also pass through holes in the body in order to retain the arms k_1 and still allow

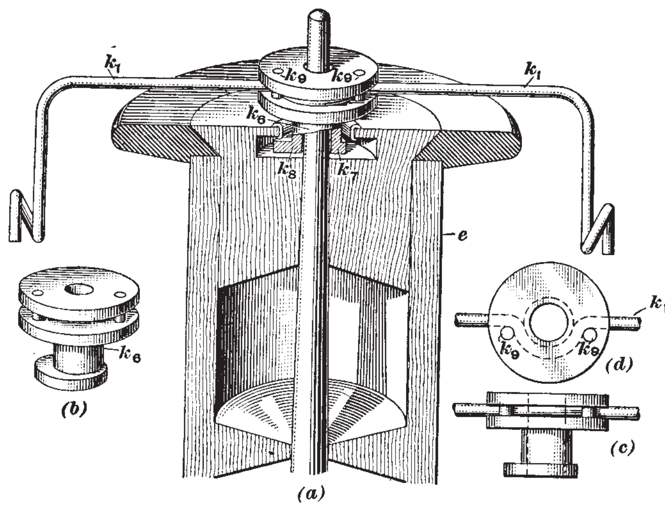

Fig. 16

the latter to be easily removed for rewiring when necessary. The position of the wire arms and the location of the pins may be readily seen in (*c*) and (*d*).

98. When a flyer of the type shown in Fig. 16 is used, the bobbin must be of special construction. It is made with a metal ring set in one head with its edges turned over the flange in the head of the bobbin. The opening through this ring is about $\frac{3}{8}$ inch in diameter, while the opening hollowed in the barrel is $\frac{5}{8}$ inch in diameter. When the bobbin is placed on the spindle, the lower part of the flyer is inserted through the opening in the ring, which easily accommodates it. The bobbin and flyer should then be placed on the spindle. When in position, the spindle offsets the flyer so that the eccentric part k_8 farthest from the spindle will be under the lip of the metal ring, and hence the flyer cannot be removed from the spindle until the bobbin is removed. As in the other flyers, the hole in the body is sufficiently large to allow the flyer to revolve freely on the spindle.

99. Another very simple device sometimes used instead of a flyer in twisting ply threads is called a *spinning disk*. It consists of a thin, flat piece of fiber measuring about $\frac{1}{8}$ inch in thickness and about 1 inch greater in diameter than the head of the bobbin; hence, it projects about $\frac{1}{2}$ inch beyond the head of the bobbin. At the center of the disk is a hole slightly larger in diameter than the spindle blade, or of about the same diameter as the hole in the flyer, that allows the disk to turn freely on the blade while resting on the bobbin. In operation, the disk is placed on the spindle after the bobbin is in position, and an ordinary wooden flyer button is pushed down tightly on the spindle, thus preventing the disk from being thrown from the spindle. The disk prevents the thread from coming in contact with the head of the bobbin.

When it is desired to eliminate the use of a disk, but still retain the same manner of twisting, only a small amount of the thread is wound on the bobbins in the previous operation. Hence, when the twisting operation is begun, the head of the bobbin will function in the same manner as a disk. A disadvantage of this method is that the heads of the bobbins in handling are likely to become scratched, which would break the filaments or injure them. The disks, on the other hand, would not be subjected to such usage and consequently would not be injured; and if they become scratched, they may readily be smoothed.

SILK THROWING
(PART 5)

Serial 5002E — Edition 1

EXAMINATION QUESTIONS

Notice to Students.—*Study the Instruction Paper thoroughly before you attempt to answer these questions.* **Read each question carefully and be sure you understand it;** *then write the best answer you can. When your answers are completed, examine them closely and correct all the errors you can find; then mail your work to us.*

(1) Why are doubler take-up bobbins constructed with tapered holes?

(2) (*a*) What two types of spindles are in general use on spinners? (*b*) What important object is accomplished by the spring f_2, Fig. 11 (*a*)?

(3) What is meant by ballooning, and what causes it?

(4) A doubler take-up bobbin is held as when placed on a twister spindle and the end is pulled, causing the bobbin to revolve in a clockwise direction. State whether right twist or left twist will be produced.

(5) Explain what is meant by the terms up-spinning and down-spinning.

(6) Why are doubler take-up bobbins wound with a quick traverse?

(7) Explain why rust-proof bobbin heads should be employed when the silk is to be steamed on the bobbins.

(8) What is meant by doubling over the head of the bobbin and why is this method sometimes adopted?

(9) Explain why second-time machines are frequently used for both first-time and second-time spinning.

(10) When a geared, or positive, take-up is used on twisters, how is the variation in the turns of twist, incurred because of the changing diameter of the bobbin, equalized?

(11) If it is desired to double only four ends on a doubling frame previously used for doubling six ends, what should be done with the extra drop wires?

(12) In connection with throwing operations, explain fully what is meant by the single-process method.

(13) (*a*) Explain the reason for employing a stop-motion on the doubler. (*b*) Fully describe the object of the lead balancing weight f_{11}, Fig. 3.

(14) Why are iron-headed spindles usually employed on a doubler?

(15) What two important purposes are accomplished by a flyer?

(16) (*a*) What would be the result if a poorly spliced spindle belt were employed on a spinning frame? (*b*) Explain how a constant tension of the spindle belt is maintained.

(17) Explain why cork is a desirable material for covering the take-up rolls of spinners.

(18) What is the object of doubling?

(19) When and for what purpose are idlers employed on spinning frames?

(20) Describe and explain the use of the spiral tension wire employed on a spinning frame.

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